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PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 41. Issued December 8, 1944

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RECENT LITERATURE[1]

STONEFLIES OF SOUTHWESTERN BRITISH COLUMBIA. By William E. Ricker. Indiana University Publication, Science Series No. 12, 1943. Sold by the Indiana University Bookstore, Bloomington, Ind., at $1.50.—This fine paper of 145 pages and 129 text figures includes keys for identification, from families down to species. The following points are fully discussed: geography and climate of the region; the streams; classification of the stoneflies; ecological distribution of the species; environmental distribution of related forms; fauna of neighbouring regions; descriptions of species. There is also a systematic checklist of species and a list of literature cited.

BRITISH COLUMBIA DRAGONFLIES WITH NOTES ON DISTRIBUTION AND HABITS. By F. C. Whitehouse. Amer. Midland Naturalist 26: 488-557, ill. Notre Dame, Ind., 1941.—This article gives many interesting and useful data. It will be of use chiefly to those who have other means of getting their species identified, as it does not contain keys. Mr. Whitehouse may still have reprints for distribution; his address is 1109 Burnaby St., Vancouver.

THE CADDIS FLIES, OR TRICHOPTERA, OF ILLINOIS. By Herbet H. Ross, Illinois Nat. Hist. Survey, Bul. 23 (Article 1): [6 +] 1-326, frontispiece and 961 text figs., many compound; p. 290, 302, 312 are blank. Natural Resources Bld., Urbana, August 1944. $1.00.—This report, the result of 12 years of field work and study by Dr. Ross and his associates, cannot be too highly praised. Dr. Ross has long since proven himself a first rate taxonomist, and his work is here enhanced by a series of beautiful photographs and excellent drawings, the latter by Dr. Carl Mohr and Miss Kathryn Sommermann.

In addition to the keys to and technical descriptions of the species known from Illinois, the following points are discussed and illustrated: biology; habitat preference; distribution; collecting and preserving; classification; key to the families (larvae, pupae, adults. A number of new species, not from Illinois, are described in the text, p. 268-289; one is from Vancouver, B.C.

"As the work progressed it became apparent that a study of the entire North American Fauna was necessary to identify properly the Illinois species . . ." (from foreword by T. H. Frison). One result of this is a fine "Check List of Nearctic Trichoptera," p. 291-303. In this the arrangement is taxonomic; generic and specific synonyms are given, many of the latter being here announced for the first time. Each species is followed by a reference to its original description, an indication of its distribution, and the genera in which it was originally described. There is a list of literature cited and an excellent index.

COMPARATIVE EXTERNAL MORPHOLOGY, PHYLOGENY, AND A CLASSIFICATION OF THE BEES (HYMENOPTERA). By Charles Duncan Michener. Amer. Museum Nat. Hist., Bul. 82 (Article 6): 151-326, 246 text figs., 13 diagrams; p. 152, 156, 313 are blank. New York, April 10, 1944.—Here at last is a work in which one may key out to genera the North American bees. Dr. Michener published his first papers on bees while still a high school student; the present article is essentially his thesis for the Ph. D. at the University of California, Berkeley.

The paper is divided into 4 parts: (1) External morphology of **Anthophora edwardsii** Cresson. (2) Comparative external morphology of bees. (3) Phylogeny of the bees. (4) A classification of the bees. The section on morphology is thorough. The part on classification includes a (phylogenetic) key to the families, with subsequent keys down to genera and some subgenera. In addition there is an artificial key to the North American genera. Numerous references to the bees of other regions indicate the broad basis of the study. The figures are grouped on p. 303-317, and are noteworthy for the full naming of parts; one does not have to consult a list of abbreviations. The literature cited is given in full, and there is an index of taxonomic names.

BRITISH COLUMBIA PROVINCIAL MUSEUM. HANDBOOK SERIES.—Officers of the Museum at Victoria are to be congratulated on these informative booklets, which though not dealing with entomology, are of the greatest interest to naturalists of the Province. They may be obtained from the Director, price 25 cents each.

Handbook No. 1. Fifty Edible Plants of British Columbia. By G. A. Hardy. 54 p., 50 figs. December 1942. The illustrations in this are rather sketchy.

Handbook No. 2. The Amphibians of British Columbia. By G. Clifford Carl. 62 p., 27 figs. June, 1943. This and No. 3 contain simplified keys for the identification of species, and beautiful illustrations by Staff Artist Frank L. Beebe.

Handbook No. 3. The Reptiles of British Columbia. By G. Clifford Carl. 60p., 18 figs. April, 1944. An Appendix gives up to date information on the treatment of rattlesnake bite, and on the care of reptiles in capitivity.

[1] Since not all our members recive journals reviewing the literature, attention is here drawn to several recent papers which deal in whole or in part with British Columbia species, or which contain keys for the identification of genera and higher categories.—H.B.L.

CORRECTIONS, VOLS. 38 & 40

The past four volumes of the Proceedings contain several errors in spelling, all of which may be recognized and corrected by the readers. Three more serious errors in Vol. 38, and one in Vol. 40, not present in the original manuscripts, should be called to your attention.

Number (=Volume) 38

(A) Page 12, line 13: "uncovered" should be "covered."

(B) Pages 14-15. The titles for Figs. 1 and 2 were transposed; 50 copies were mailed before this was noticed. Fresh titles on glued paper were printed immediately and sent to those 50 subscribers; all stock on hand was corrected. All copies should thus have the illustration on p. 14 labelled as Fig. 2 and that on p. 15 as Fig. 1.

(C) Page 31, line 17: "September" should be "November."

Volume 40

(D) Inside of front cover, List of Members: John Stainer's name should be preceded by an asterisk.

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PRESIDENTIAL ADDRESS

J. R. J. LLEWELLYN JONES, M.A., F.R.E.S.

It is my pleasure to welcome the members of our Society to the 43rd Annual Meeting, held unfortunately while still under the shadow of war, but with the increasing hope that victory and peace may not be long delayed.

Since the last Annual Meeting our Society has suffered the loss by death of three of its senior members.

Mr. M. H. Ruhmann, our Honorary President, who had been in ill health for some little time and whose passing was not entirely unexpected. He was well known to many of you and will be greatly missed by those who knew him best.

Mr. A. W. Hanham of Duncan, Vancouver Island, who also for some few years had been in failing health, was 86 years old at his death. For many years he had shown a keen interest in many branches of Natural History and was a keen collector of Lepidoptera and of other orders of insects, as well as in other fields of Natural History

Mr. W. B. Anderson at the age of 87, who in the past took an active interest in our Society.

I refrain from further comment on their work and leave that to more competent members who had the privilege of knowing them better than I.

I ask the meeting to rise as a token of respect. May their souls rest in peace, and may perpetual light shine upon them.

The Secretary-Treasurer will shortly present his Financial Statement which I think you will consider satisfactory under the present difficult conditions due to the prolongation of war. He reports a credit balance of $44.91.

The Endowment Reserve Fund shows a small increase, and I should like to take this opportunity to put forward with a view to discussion later, after you have received the Statement, certain suggestions as to the ways and means of making this fund more worthy of our Society.

We are looking forward to the day when we can publish the Proceedings without assistance from outside the Society, and it was to achieve this end that the Reserve Fund was primarily instituted some few years ago. I should like however, if I may be so bold, to indicate another use for the fund, if and when it has reached a reasonably large capital sum. I refer to a scholarship for needy students in Entomology to be valid at the University of British Columbia, or at some other University or College at the discretion of our Society. As a learned Society it should in some measure co-operate with the educational authorities in providing training for the coming generation of scientific men. It has been well said that "no man liveth unto himself" and by establishing such a scholarship the Society would be showing in practical form its interest in the youth of Canada, out of whom will spring our leaders in future years.

And now to return to the immediate task before us, namely to investigate ways and means of attaining our objective:

(1) An increase in the membership dues. I hesitate to recommend this in view of the ever heavier financial burdens both in the field of taxation and in the cost of living imposed upon us by reason of the war. But this possibility should not be overlooked as a source of increased revenue.

(2) Increase of membership to a number which would allow the dues received, together with other sources of revenue, to cover the cost of publishing the "Proceedings" and financing our Society, and yet leave a reasonable sum to be transferred to the Reserve Fund each year.

It will be necessary to go outside the ranks of the professional entomologists, remembering that anyone interested in the scientific study and collection of insects would be a welcome acquisition to the Society. Our schools and universities together with the teaching profession should form a source of supply. There are many too in the learned professions who are interested in scientific work.

I am informed that there are nine names of candidates put forward for membership and that they will come up for election at this meeting. I extend to them, on your behalf, a hearty welcome.

(3) A contribution to the cost of publication of the "Proceedings" from those submitting papers for publication. This is in force at least in principle at the present time in that members requiring "separates" of their papers are now charged for them at a set rate.

(4) By means of bequests. For generations past this has been the means of providing endowments for schools, colleges, universities and learned Societies, and if some of our members were to leave even only a small sum to the Society in their wills, eventually our goal would be reached.

I commend these suggestions to your careful consideration and comment later.

And now to pass from the consideration of matters of concern only to our Society. Let us consider together briefly the part played by entomologists at the present time and the part that they should play in the future, after the war has been won and peace has been restored.

As is only right in such times as these economic entomology has been pressed forward and redoubled efforts made to promote the well-being both of the armed forces and the civilian population. The general public however, takes a good deal of educating and unfortunately we are still not very far remote from the attitude of mind which some years ago caused the will of a certain Lady Glanville to be disputed on the grounds that, as she was interested in butterflies, she was of unsound mind. True we have advanced a little beyond this stage, but still, in the minds of many, the entomologist is rather a curious person and certainly a little eccentric, but not to the extent of being dangerous.

Possibly we are somewhat to blame ourselves in this respect in that we have not sought sufficient publicity for our efforts in the public good. However the labours of entomologists, in co-operation with medical science, to control and cope with tropical diseases, many of which are spread by various species of insects are being more widely known and are receiving greater publicity. Also the part that entomological research plays in the protection of the farmer's crops and the preservation of his herds, all so important at the present time, is being more generally realised and appreciated. On matters of public health too, the entomologist keeps a watchful eye, and from time to time gives warning of trouble ahead to the public bodies concerned, but unfortunately city Corporations and the like do not always lend a sympathetic ear, however timely the warnings, or however tactfully they may be given. Despite these discouragements the entomologist continues his labours hoping for the co-operation of the authorities concerned, and of course in many instances getting it, and looking for the sympathetic understanding of the general public to the end that the health and well-being of the community at home may be assured and the fighting services protected abroad.

And now as to the place of entomological research after the war. Economic entomology will continue to render service as now, to the medical profession, to public health authorities, to agriculture and to forestry; the findings of entomologists will be at the disposal of the departments concerned without restriction or reserve.

There is however another side of entomological research, which ought not to be overlooked or shoved into the background, which is concerned more with the advancement of scientific knowledge for its own sake than for material results.

As a scientific society, do not neglect the purely scientific side of the picture in an eagerness for material results and the plaudits of a public which unfortunately is all too apt to judge its values by a norm of dollars and cents.

Now science is a search after truth, and truth is a fundamental element, if we are to have after the war that "better world" which many politicians and others are promising us. Men of science are seekers after truth in that they probe the

laws whereby the universe and all that it contains are governed. The more science is able to tell us of the laws of nature the better we shall be fitted to face the problems which lie ahead, in that we shall possess more enlightened minds, and less narrow outlooks.

We hear much these days of international co-operation and of the greater necessity for understanding other people's point of view, if we are to have a just and lasting peace. Science and truth have this attribute in common, that they know no hindrance of race or creed and are thus truly international, and therefore can be of immense value in producing harmony between the varied peoples and races of the world. The scientist therefore has a great and important duty to discharge for the ultimate well-being of the race.

Our Society already realizes the value of international friendship and co-operation as is evidenced by the number of members from the United States of America whose names appear on its roll. This membership is highly esteemed and augurs well for the future well-being of the Society, and is indicative that its members are fully aware of the part that they may play, as messengers of good will, in bringing into being that dream of a better world.

SOME FOOD PLANTS OF LEPIDOPTEROUS LARVAE. List No. 10

J. R. J. LLEWELLYN JONES
Cobble Hill, B. C.

An asterisk (*) denotes that the species has been mentioned in these lists previously, and that the information now offered is either additional, or is an amplification of what has already been reported. Records in this list are supplied by the author.

Heterocera

**Acronicta (Apatela) fragilis fragiloides* B. & Benj. June-berry *(Amelanchier alnifolia* Nutt.), and species of plum (garden varieties).

**Acronicta (Apatela) funeralis* G. & R. Alder *(Alnus rubra* Bong.).

**Acronicta (Apatela) grisea revellata* Sm. Alder *(Alnus rubra* Bong.).

Acronicta (Apatela) lepusculina cyanescens Hamp. Willows *(Salix scouleriana* (Hook.) Barr., *Salix barclayi* Anders.).

**Amphidasis (Lycia) cognataria* Gn. English oak *(Quercus robur* L.), hazel *(Corylus rostrata* Ait.), species of huckelberry *(Vaccinium)*, species of plum and raspberry (garden varieties).

**Dicentria semirufescens Wlk. (Ianassa semirufescens)*. English hawthorn *(Crataegus oxyacantha* L.), and Judas tree (Cercis canadensis L.).

Gabriola dyari Tayl. Douglas fir *(Pseudotsuga taxifolia* (Lamb.) Brit.

**Paonias excaecata* A. & S. June-berry *(Amelanchier alnifolia* Nutt.), species of plum (garden varieties), and species of cherry (ornamental varieties).

Sarrothripus revayana lintnerana Speyer.
Sarrothripus revayana columbiana Hy. Edw.
Sarrothripus revayana cinereana N. & D.
— Willow *(Salix scouleriana* (Hook) Barr., *Salix hookeriana* Barr.) and probably on species of oak.

**Schizura unicornis* A. & S. June-berry *(Amelanchier alnifolia* Nutt.), and species of cherry (garden varieties).

**Synaxis jubararia* Hlst. Red flowered currant *(Ribes sanguineum* Pursh.).

VIRTUAL ABSENCE OF VESPINE WASPS IN THE SUMMER OF 1944 (Hymenoptera, Vespidae). Unusual number of overwintered queens of Vespula spp., both the yellow and black "yellowjackets" and the white and black "hornets", were seen visiting the flowers of cultivated currants and gooseberries in the spring of 1944. Few of tthe queens succeeded in establishing broods. The scarcity of wasps in the southern interior of British Columbia has been commented upon by entomologists, foresters and laymen. The writer has seen but a single wasp and no nests during the summer, while many persons have reported not seeing any wasps at all.—Hugh B. Leech.

THE DISTRIBUTION OF SOME PLAGUE-IMPORTANT RODENTS AND FLEAS IN WESTERN CANADA

(Mammalia: Rodentia, and Insecta: Siphonaptera)[1]

George P. Holland
Livestock Insect Laboratory, Kamloops, B. C.

Foreword.—In 1938, surveys of some of the commoner species of rodents occurring in British Columbia and Alberta were initiated, with a view to determining whether sylvatic (=bubonic) plague had become introduced to those two provinces. Gibbons (1939) stated: "Most of the observers are of the opinion that the west coast of North America became infected in the course of the plague pandemic of 1894 which originated in Hong Kong and reached America at least by 1900. Wild rodents probably became infected through contact with domestic rats and the infection spread until it is now present in nine of the western states, including Washington, Idaho and Montana, which border on the provinces of British Columbia and Alberta. The history of the progress of the infection northward and eastward through the western sections of the United States forces us to consider that the infection may have extended to Canada, or if not, may be expected to do so within the next few years."

Accordingly, surveys were organized by the Health Departments of these two western provinces, under the direction and advice of the Dominion Department of Pensions and National Health and the Livestock Insect Laboratory, of the Division of Entomology, at Kamloops, B.C. During the first season (1938), tissue and flea specimens were tested at the George Williams Hooper Foundation in San Francisco. In 1939, and subsequently, the tests were conducted at the newly constructed Laboratory of Hygiene at Kamloops.

In 1938 the attention of the Alberta crew was drawn to the case of a mink farmer of Stanmore, Alberta, who had died the previous year of an acute septicaemia resulting from an injury to his finger incurred while skinning a mink. This mink, with a number of others, had died following the use of ground squirrels (*Citellus r. richardsonii* (Sabine)) from a nearby area, as food. In 1939, *Pasteurella pestis* was demonstrated in ground squirrels and their fleas, from this particular locality, and the infection was found to be present over at least four townships, embracing an area of 144 square miles (Gibbons and Humphreys, 1941).

In 1941, plague was demonstrated in *Citellus r. richardsonii* in Divide County, North Dakota (Public Health Reports, 1942) immediately south of the Saskatchewan border. In 1942, a survey of southern Saskatchewan, based on the system used in British Columbia and Alberta, was instituted by the Health Department of that province and carried out under the supervision of the writer.

In 1943, the Royal Canadian Army Medical Corps conducted an investigation of the ground squirrels and rats occurring in the vicinity of military camps in the provinces of Alberta, Saskatchewan and Manitoba.

As a result of all these surveys, considerable data have been accumulated on the distribution of important rodents and fleas and form the subject matter of the present paper.

General Considerations.—Western Canada has been, and is, exposed to two principal avenues whereby plague might be introduced: (1) through the spreading of the disease from infected ground squirrel or other native rodent colonies in the adjoining states of Washington, Idaho, Montana and North Dakota, where it is known to be established (as has already occurred in Alberta), and (2) through the introduction of plague-infected rats, conveyed by shipboard from foreign lands

[1] Contribution No. 2315, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

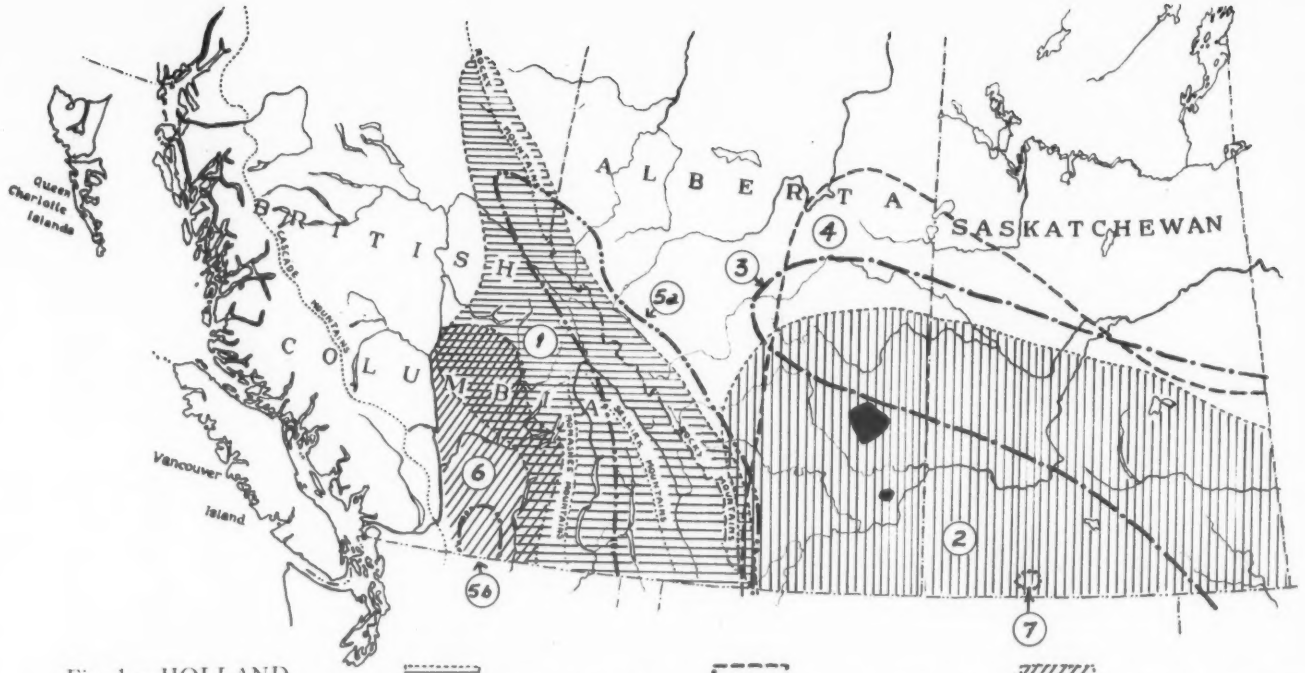

Fig. 1.—HOLLAND

The approximate distribution of some native rodents in Western Canada. (Rodent distribution partly from Howell (1938) and partly from records at the Kamloops Laboratory. Plague areas from literature references: Brown and Roy 1943; Gibbons and Humphreys 1941; Public Health Reports 1943).

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to our Pacific seaports, all of which are heavily infested with rats, the natural carriers of plague.

Also to be considered is the possibility of infected rats being brought north by train from such cities as San Francisco, Tacoma and Seattle, where plague has been recorded in these rodents. Again, there is the possibility of the disease spreading from infected prairie ground squirrels to the rat populations in certain southern towns and cities.

However, the present article is concerned primarily with the distribution of the potential carriers and vectors of plague, as revealed by the results of the surveys of British Columbia, Alberta and Saskatchewan. Not sufficient data are available, as yet, for a detailed account of the situation in Manitoba.

While a fair number of rodents of both native and introduced species have been incriminated with regard to plague transmission in the United States, investigations in Canada have been restricted to comparatively few forms, such mammals as the tree squirrels (*Tamiasciurus* spp.), flying squirrels (*Glaucomys* spp.) woodrats (*Neotoma* spp.) and mice (*Peromyscus, Microtus, Mus,* etc.) being ignored, or collected only as opportunity offered. However, much attention was given to ground squirrels of several species (particularly two), introduced European and Asiatic rats, and, to a much lesser extent, marmots, prairie dogs and chipmunks.

Distribution of the Rodents

A. Indigenous Species.—Fig. 1.

(1) Columbian ground squirrel, *Citellus columbianus columbianus* (Ord).

The range of the Columbian ground squirrel covers a large area in southeastern British Columbia, and fringes the southwest boundary of Alberta. It is, in fact, rather closely confined to the Rocky, Selkirk and Monashee mountain systems, with their related foothills and valleys. Habitat types vary from open fields in the bottomlands to alpine meadows at 7,000 to 8,000 feet altitude. According to local reports it is only in comparatively recent years that these ground squirrels have been seen in any numbers west of the North Thompson River. They occur now as far west as Lac la Hache and 150 Mile House along the Cariboo Highway, and are very common in the Horsefly Lake region. In the Columbia and Kootenay valleys they frequently occur in large colonies, and in some areas constitute a serious agricultural menace.

Southward, these rodents extend into Washington, Oregon, Idaho and Montana. Eskey and Haas (1940) reported plague in this species, from tissue samples and fleas collected at Wallowa Country, Oregon.

(2) Richardson ground squirrel, *Citellus richardsonii richardsonii* (Sabine).

This mammal, locally known as the "prairie gopher" is the commonest and and most conspicuous rodent of the great plains of Alberta, Saskatchewan and Manitoba. Aside from its potentialities as a disease carrier, its depredations to crops and interference with irrigation combine to make it an economic problem of prime importance. Its distribution, and the areas where plague infection has been demonstrated are shown on Plate 1.

In the United States, plague has been shown in this rodent in Beaverhead County, Montana (Eskey and Haas) and Divide County, North Dakota (Public Health Reports, 1942). The status of this mammal in Canada has recently been treated by Brown and Roy (1943).

(3) Franklin ground squirrel, *Citellus franklinii* (Sabine).

This rodent, sometimes known as the "gray gopher," "brush gopher" or "bushy-tail" is widespread across the prairie provinces, but is chiefly confined to the lightly treed areas, rather than on the open plains. In the United States, it is found in North and South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Illinois and Indiana.

Very few specimens of this mammal have been collected by the Canadian survey crews, principally because plague investigations have been conducted chiefly in the

extreme south of the prairie, while the Franklin ground squirrel is more abundant farther north.

(4) Thirteen-lined ground squirrel, *Citellus tridecemlineatus tridecemlineatus* (Mitchill).

This ground squirrel, usually known locally as the "striped gopher," is much more widespread in the prairie provinces than *C. r. richardsonii*, but in the areas covered by the survey crews, has not proved to be common. Only a few specimens have been collected, in scattered localities, in Alberta and Saskatchewan. *C. t. tridecemlineatus* and related subspecies occur all through the central United States.

(5) Mantled ground squirrels, *Citellus (Callospermophilus)* spp.

Plague has been demonstrated in ground squirrels of the subgenus *Callospermophilus* in several counties of California (Eskey and Haas). Flea species present were *Diamanus montanus* (Baker), *Oropsylla idahoensis* (Baker) and *Monopsyllus eumolpi* (Rothschild), the last two of which occur commonly in Western Canada on a number of hosts.

The dusky mantled ground squirrel, *Citellus saturatus* (Rhoads) is found in the east Cascades, in the extreme south of British Columbia. Hollister's mantled ground squirrel, *C. lateralis tescorum* (Hollister) is found in the Rocky and Selkirk mountain regions. Neither species has been collected in any great numbers by the survey crews.

(6) Pallid yellow-bellied marmot, *Marmota flaviventris avara* (Bangs).

The yellow-bellied marmots or "groundhogs" are confined chiefly to the "Interior Dry Belt" of British Columbia, in some localities of which they may occur in considerable numbers, especially if large rock piles are available for protection. *M. f. avara* is found in the Fraser Valley as far south as Hope, and extends to the north as far as Williams Lake. It ranges southward through the Okanagan Valley into Washington, Oregon and northern Nevada. Related subspecies are found in all the western and Pacific States, with the possible exception of Arizona. Fair numbers of *M. f. avara* have been collected by the British Columbia survey crews, and also a few individuals of *M. caligata* ssp., the hoary marmot, in areas at high altitude.

Plague has been demonstrated in marmots (probably *M. flaviventris nosophora* Howell) in Montana and Wyoming (Eskey and Haas).

(7) Black-tailed prairie-dog, *Cynomys ludovicianus ludovicianus* (Ord).

Prairie-dogs are known from one locality in Canada, in a coulee bottom, thirteen miles southeast of Val Marie, in southern Saskatchewan, where a single large colony exists. The Saskatchewan survey crew has collected a number of these mammals.

In the United States, plague has been demonstrated in *Cynomys parvidens* Allen (Garfield County, Utah), *C. leucurus* Merriam (Uinta County, Wyo.) and *C. gunnisoni zuniensis* Hollister in New Mexico and Arizona (Eskey and Haas).

(8) Chipmunks. *Eutamias* spp.

Chipmunks of many species and subspecies occur in Western Canada. A small number (mostly *E. amoenus affinis* (Allen), and *E. amoenus luteiventris* (Allen)) were collected by the British Columbia crew. While these rodents occur in Alberta and Saskatchewan (mostly *E. minimus borealis* (Allen)), very few were collected due to the fact that they occur principally in the lightly treed areas, whereas the bulk of the survey work was carried out on the open prairie.

Plague was recovered from *Eutamias* spp. in various localities in California and Nevada (Eskey and Haas).

B. INTRODUCED SPECIES.

(9) Norway rat, *Rattus norvegicus* (Erxleben).

The Norway rat, house rat or sewer rat, a native of the Old World, was introduced to North America in the middle of the 18th Century. Since that time, the original stock has multiplied and spread, and also there have been successive in-

vasions of seaport towns of rats from poorly tended vessels docking there. This undesirable rodent has followed man to nearly all corners of the globe and, once established in any locality, is very difficult to eradicate. Plague is a natural disease of this and related species, and the fleas of rats are ideally adapted to the dissemination of this disease, partly because of their peculiar physiology, which renders them readily infective, and partly because of their readiness to bite man. These facts, coupled with the rats' tendencies to become established around domestic households, make the rat and rat flea situation a public health menace of grave concern.

In Western Canada, rats are localized to a certain extent. Apparently they occur in most, if not all, seaport towns from Vancouver to Prince Rupert, as well as on Vancouver, Queen Charlotte, and doubtless other islands. They are found commonly in the lower Fraser Valley, around Chilliwack, Hope, Harrison Bay, Agassiz, etc.

They occur in garbage dumps, warehouses, waterfront docks, in lanes in the residential areas where they feed on garden refuse and garbage from poorly tended tins, around stables, restaurants, abattoirs, in houses, grain elevators, and in fact, any place where an easy living may be obtained.

In the Interior of British Columbia they seem to be rare, and this apparently holds good for most of Alberta also, although we have records from Calgary.

Southern Manitoba is apparently well populated, and Saskatchewan, while virtually free of rats a few decades ago, now shows a steady increase in numbers of these rodents, and a very definite spreading westwards and northwards. The Sanitation Division of the Provincial Health Department has prepared an interesting map, showing the influx and advances of rats, year by year.

Southern cities, such as Regina and Moose Jaw, are now heavily infested, as also is Saskatoon. In Estevan, rats and Richardson ground squirrels were noted in large numbers in the same garbage dump, and this only ten miles or less from the plague focus in North Dakota! Furthermore, ground squirrel fleas *(Oropsylla rupestris* (Jordan)) were recovered from the rats. Here then is the ideal opportunity for the rats to pick up the infection from the ground squirrels!

(10) Black rat, *Rattus rattus rattus* (Linnaeus).

The black rat, a smaller and longer-tailed species is comparatively rare in this country, only a few specimens having been collected, and these usually in waterfront warehouses at the coast. It apparently has to give way before the more powerful Norway rat. They both carry the same species of fleas, but *R. r. rattus* is not now common enough to constitute a serious problem.

(11) Roof rat, *Rattus rattus alexandrinus* (Geoffroy).

This rodent, like the black rat, is comparatively rare, and known only from the coast areas.

Distribution of the Fleas

These rodents have been found to be infested with a wide variety of fleas of which fifteen species were fairly common to very common, and which are of varying importance as potential plague vectors. Their relationship to the rodent hosts is summarized in Table I.

A. INDIGENOUS SPECIES.

(1) *Monopsyllus eumolpi* (Rothschild).

M. eumolpi is a common and regular parasite of western chipmunks (genus *Eutamias)* and is found wherever these mammals occur. In British Columbia it is quite frequently collected on the Columbian ground squirrel when habitat association offers the opportunity. It has been proved to transmit plague experimentally in the laboratory (Eskey and Haas). We have several records of this insect biting man.

TABLE I
Species of Fleas Found, and Relationship to Rodent Hosts

	Hosts									
	Rattus spp.	Citellus c. columbianus	Citellus r. richardsonii	Citellus franklinii	Citellus 13-lineatus	Callospermophilus spp.	Marmota flaviventris avara	Cynomys l. ludovicianus	Eutamias spp.
Indigenous Species									
1. Monopsyllus eumolpi...		*							†
2. Neopsylla inopina.....		†	†	*	*				
3. Opisocrostis bruneri...			*	†	*				
4. Opisocrostis labis.....			†	*				*	
5. Opiso.t.tuberculatus...		†	†	*	*				
6. Oropsylla idahoensis...		†				†			
7. Oropsylla rupestris....	*		†	*†	*†			*	
8. Rectofrontia fraterna..			†	*	*				
9. Thrassis acamantis....		*					†		
10. Thrassis bacchi.....			*	*	†				
11. Thrassis petiolatus....		†							
Introduced Species									
12. Ctenocephalides canis..	*								
13. Ctenocephalides felis...	*								
14. Nosopsyllus fasciatus..	†								
15. Xenopsylla cheopis....	†								

† True or typical parasites of the host concerned.
* Frequent records, but relationship due to habitat association.

(2) *Neopsylla inopina* (Rothschild).

N. inopina is a true ground squirrel flea and as it is blind it may be chiefly confined to the nests and burrows of the host. It is common on *Citellus r. richardsonii* in Alberta and Saskatchewan, and occurs on *C. c. columbianus* in the extreme southeast of British Columbia. It has not been demonstrated to be a potential plague vector —nor has it been recorded infesting man's person.

(3) *Opisocrostis bruneri* (Baker).

This flea, recently demonstrated to be an efficient plague carrier (Prince, 1943) also occurs on ground squirrels. While sometimes taken on *Citellus richardsonii* and *Citellus 13-lineatus*, it is more usually found on the Franklin ground squirrel.

(4) *Opisocrostis labis* (Jordan and Rothschild).

O. labis is a true parasite of *C. richardsonii* and is widespread and common on the Canadian prairie. It has been shown to transmit plague (Eskey and Haas). This species does not occur on British Columbia ground squirrels.

(5) *Opisocrostis t. tuberculatus* (Baker).

This, like the above species occurs on the ground squirrels of Alberta and Saskatchewan, and is capable of transmitting plague (Eskey and Haas). It is found also on *C. c. columbianus* in the Kootenay district of British Columbia.

(6) *Oropsylla idahoensis* (Baker).

This species is very common on the Mantled ground squirrel *(Callospermophilus)* and also is one of the two common and regular siphonapterous parasites of *Citellus c. columbianus*. In Canada it seems confined to British Columbia and the foothills of Alberta. According to the experiments of Eskey and Haas (1940), it seems resistant to plague infection.

(7) *Oropsylla rupestris* (Jordan).

This is the commonest flea of *Citellus r. richardsonii*, and its range is probably coincident with the distribution of that rodent. It has been taken on rats (R.

norvegicus) where the two rodent hosts are in contact (as in southern Saskatchewan). As it is capable of transmitting plague (Eskey and Haas) it is probably one of the most potentially dangerous of our native fleas, as it offers the possibility of this disease spreading from the native ground squirrels back to the rat population of the southern prairie. Although we have no records, it almost certainly occurs also on the Franklin and 13-lined ground squirrels where the ranges of these mammals overlap that of the Richardson ground squirrel.

(8) *Rectofrontia fraterna* (Baker).

R. fraterna is a small blind flea that occurs on fair numbers on ground squirrels and other rodents east of the Rockies. Like *N. inopina* it may be chiefly a nest flea, and like that species it has not been incriminated with disease transmission. It also occurs (rarely) in British Columbia, on a variety of hosts.

(9) *Thrassis acamantis* (Rothschild).

While on rare occasions this species is taken on other hosts, it is an extremely common parasite of the yellow-bellied marmot *(M. flaviventris avara)* and occurs throughout the range of this rodent in British Columbia. It has been shown to be infective under laboratory conditions (Eskey and Haas).

(10) *Thrassis bacchi* (Rothschild).

T. bacchi occurs on all the prairie ground squirrels, especially *C. 13-lineatus*, but seems to be rather rare in Canada. It is of potential significance as a plague carrier (Prince, 1943).

(11) *Thrassis petiolatus* (Baker)

T. petiolatus is an extremely common parasite of *Citellus c. columbianus* in British Columbia. Like the other common flea of this rodent *(Oropsylla idahoensis)* it is resistant to plague transmission (Eskey and Haas). In view of the fact that the two most common fleas of this rodent are not readily infected, the Columbian ground squirrel is very likely not of so much potential significance as the Richardson ground squirrel, as the latter carries at least five species of plague-important fleas.

B. INTRODUCED SPECIES.

(12) *Ctenocephalides canis* (Curtis).

(13) *Ctenocephalides felis* (Bouche).

These two fleas are widespread in their distribution, and commonly infest domestic pets, particularly cats, dogs and rabbits. Heavy infestations frequently occur in households, and as both these species feed readily on man, they are often a serious domestic problem.

Large numbers of these fleas sometimes occur on the rats in certain garbage dumps in Vancouver.

(14) *Nosopsyllus fasciatus* (Bosc d'Antic).

This, the European rat flea, is well established in Canada and is probably coincident in its distribution with *Rattus norvegicus*. Though not as highly significant as the next species, this flea is of definite importance as a possible disseminator of plague.

(15) *Xenopsylla cheopis* (Rothschild).

X. cheopis, the Indian rat flea or "plage flea," occurs more commonly in tropical than temperate regions. However, it does become well established in these latitudes and wherever it occurs its presence is a matter of gravest concern, as it is the most important of the flea vectors of plague.

The possibility of its occurrence in Vancouver was first suggested by Spencer (1937), and in 1938 specimens were recognized by the writer (1940). This constituted the first Canadian record. In 1941 Holland discussed the status of this flea in the coastal area in British Columbia. It was found that a significant percentage of the rat fleas in the Vancouver city garbage dump was of this species. It was also recorded from New Westminster. Continued surveys since that time have shown *X. cheopis* to be widely distributed throughout the residential area of Vancouver, where the spread of its rodent host is undoubtedly assisted by the carelessness of the residents with reference to garbage

disposal. *X. cheopis* also is known at North Vancouver and Sechelt.

Summary and Discussion

The distribution and status of eleven kinds of rodents and fifteen species of fleas are briefly discussed with reference to the possible dissemination of plague in Western Canada. Both the mammals and their parasites vary considerably as to their infectivity. The host specificity, and relative tendencies of fleas to bite humans are of importance from a public health standpoint.

Undoubtedly there are other mammals in our fauna that might be considered as possible carriers of this disease, and also there are undoubtedly many other species of fleas capable of transmitting plague from host to host, or from host to man. Records at the Kamloops laboratory include at least fourteen species of fleas present in Western Canada which will bite man readily. The plague-disseminating propensities of most of these are not as yet known.

Mice of various genera have not been studied extensively in Canada with reference to plague, but, in the United States, the white-footed mouse (*Peromyscus* spp.) has been incriminated to a limited extent (Eskey and Haas). The potentialities of some of these smaller rodents should not be overlooked.

Birds, especially hawks and owls, which prey upon mice and ground squirrels are also a possible factor in the spread of infection (Jellison, 1939). Small carnivores such as weasels might be considered in a like manner.

At the present time, concentrated eradicatory measures are being taken against the rat population by various civic health authorities. Also should be mentioned, the very creditable effort at ground squirrel control in the vicinity of the known plague foci of Alberta, which has been conducted by the Health Department of that Province. It is to be hoped that these measures, and the continued careful surveying of native and introduced rodents and their fleas, will achieve the desired result of holding sylvatic plague in check to the point where it does not affect Canadian health and welfare.

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COMPARISON OF THE INJURY TO APPLE CAUSED BY SCALES AND APHIDS (Homoptera: Aphididae & Coccidae)[1]

A. D. Heriot
Dominion Entomological Laboratory, Vernon, B. C.

Both scales and aphids build up heavy infestations on apple and pear and both derive nourishment by piercing deeply into the plant tissues with their stylets and sucking up the plant juices. Although many differences connected with feeding exist between the fixed armoured scales and the more mobile aphids, it is generally assumed in the literature that injury to the tree is due in both cases to the loss of sap incurred by the mass feeding of these insects. Yet for some unexplained reason, scale infestation is much more injurious than aphid infestation.

Prior to the development of effective control measures, the ravages of the San Jose scale (*Aspidiotus perniciosus* Comstock) were notorious. Newcomer as recently as 1941 regards this scale, by reason of its rapid increase, "as potentially capable of doing more damage than any other insect occurring in the orchards of the Pacific Northwest."

A rapid increase in scale population without further qualification might imply a rapid depletion of the host plant. It is true that the San Jose scale with its 3 to 4 generations a season is the most prolific scale attacking apples and pear, but with its dependence on sexual reproduction involving a considerable proportion of males among its progeny, the scale cannot vie in potential reproductive power with the parthenogenetic apple aphid (*Aphis pomi* Degeer) which Newcomer credits with 9 to 17 generations in a single season.

Greater protection against natural enemies and adverse climatic conditions, may nevertheless sometimes enable the San Jose scale to outstrip the apple aphid in self-multiplication. This is less likely to occur in the case of the oyster shell scale (*Lepidosaphes ulmi* L.) which has only a single annual brood of 40 to 80 individuals that require 6 weeks to attain maturity. The eggs hatch several weeks later than those of the apple aphid and the adults after ovipositing die some weeks before cold weather puts a stop to aphid feeding. Moreover the scale confines its attention almost exclusively to the woody growth of the stems, while the apple aphid attacks both the leaves and stems. Yet in spite of slower development, inferior reproductive power and a much shorter feeding period, oyster shell scale infestation is definitely more injurious to the tree than aphid infestation. The outright killing of twigs and branches frequently occurs in neglected scale infested orchards and the same scale is capable of causing the death of the hardy native thorns and dogwoods of the Interior of British Columbia.

By comparison, the harm done by the apple aphid is insignificant and perhaps the worst feature of this orchard pest is the dense smutting of the foliage and fruit, indirectly due to the gross feeding of the aphid and the quantity of honey-dew excreted. The armoured scales on the other hand, utilize their comparatively small amount of waste material in the manufacture of their shells. It is possible that young trees encrusted with this scurfy material may suffer from an interference with the respiratory functions of the lenticels.

Be this as it may, it will be as well to look for other causes than the extraction of sap to account for the severity of scale injury, for it is hardly reasonable to assume that the slowly developing oyster shell scale is a greater drain on the plant than the more prolific aphid. In fact the question arises as to whether any insect can cause the death of a tree by the extraction of sap alone.

[1] Contribution No. 2325, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

It would seem in the case of the aphid that a state of equilibrium must inevitably be established between the ability of the plant to maintain the aphid and the ability of the aphid to reproduce on a diminishing food supply. In the case of the scale, this equilibrium, if ever reached, may be upset by some entirely different cause. It is therefore suggested that the severity of scale injury may be due, not as is generally assumed by what is taken out, but by what is actually put into the plant by the armoured scales. In this connection, the belief has sometimes been expressed that the San Jose scale injects a toxic substance into the plant when feeding. The red blotches on fruit and stems generally associated with the presence of this species, seems to be the foundation for this supposition. A less vivid discolouration occurs around the punctures of the oyster shell scale. Although it is quite possible that this scale spotting is indeed caused by the injection of a toxic secretion, it seems just as reasonable to suppose that it may be accounted for by something inserted that is more substantial and more readily demonstrated than a chemical agency. Perhaps the discolouration of the fruit known as "pansy spot" which has been traced by Newcomer to the insertion of a thrip's egg in the growing tissue may be an analagous injury.

In both scale and aphid infestations the presence of a multitude of stylets invading the tissues may conceivably be an encumbrance harmful to the plant. In heavy infestations, two or three young scales or aphids may settle on an area only a millimeter in diameter. As demonstrated by Weber (1930), each instar of the Hemiptera and Homoptera acquires a new set of stylets at each moult, a fact incidentally, that does not appear to have been accorded recognition in either British or American literature except by the author (1931 and 1934).

The replacement of the stylets at each moult means that the small area cited above will receive in the case of the scale with its three instars, three separate punctures from each of its occupants. The aphid with five instars, has an advantage over the scale in being able to move and distribute its more numerous punctures in less congested and probably more succulent areas of the growing stem. It is not however, in the number of punctures, but in the final disposal of the stylets when moulting that the scales differ so widely from the aphids. In the case of the free-moving aphids, the stylets are withdrawn from the tissues at ecdysis and are invariably found intact and attached to the cast skin. The scale cramped beneath its shell, is unable to withdraw its stylets. Instead, the old stylets are broken off at the base and left like tenuous rivets or stitches in the tissues of the bark and cambium. Longitudinal sections of scale-infested bark reveal the stylets of each instar in the positions they would be expected to assume when allowance is made for the slight movement permitted by the insect's confinement. The respective stylets are thus close together and are easily distinguishable by the their different diameters. Cross-sections of the infested bark show that the passage of the stylets is intra-cellular and the tips are frequently observed to extend beyond the cambium into the xylem.

Thus on a heavily scale-infested twig there are three sets of stylets implanted by every visible adult, but under conditions where the young frequently settle beneath the parent scale, the congestion of abandoned stylets may be much greater than might be estimated from the number of scale present at a given time.

The extraction of sap or the injection of a toxicant are only possible while the insect is living, but the disposal of stylets in the tissues by successive instars and generations evidently results in mechanical injury to the plant the year round.

It seems therefore reasonable to believe that this distinctive feature, namely the accumulation of abandoned stylets in the tissues hampering growth by a mat of chitinous stitches, may have much to do with the severity of scale injury in comparison to that inflicted by the aphid.

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FURTHER NOTES ON THE CERAMBYCIDAE OF VANCOUVER ISLAND (Coleoptera)

George A. Hardy
Provincial Museum, Victoria, B. C.

The object of these notes is to bring together scattered records that have accumulated from time to time since the 1925-26 Museum Reports (Hardy 1926-1927).

It is by no means claimed that all the data have been examined, as the Coleoptera of Vancouver Island have possibly been investigated by students and collectors who are at present unknown to the writer. In that event, should this article result in bringing hitherto unknown collectors to light, this effort will have achieved a definite purpose.

At the best, aside from the southern and eastern coastal areas of the island, information on the Cerambycidae is very meagre. This cannot altogether be due to the absence of many species, but to the fact that comparatively little intensive research has been undertaken. It is true that the habits of the members of this family are often such as to make them exceedingly elusive in relation to our affairs, so that they may be unseen yet numerous. Hot sunshine coupled with the fallen trees or newly-cut wood at just the right stage of attraction, the synchronization of favourite plant blossoms, and time of appearance, or nocturnal habits of the species, are only some of the limiting factors.

To the ardent collector, however, all the above factors add a spicy attraction, for perseverance often brings unexpected rewards. By being perennially beetle-conscious, "windfalls" occasionally occur at most unexpected moments.

The following annotated list includes only those species that seem to be of special interest either as new records, extensions of the known range, or from a biological viewpoint.

(1) *Eumichthus oedipus* LeC. New locality records: Colwood, two specimens in a collection formed during the years 1932-36, and presented to the Provincial Museum by Hedley Peake. This is the most westerly Vancouver Island record known. 10 Mile Point near Victoria, specimens taken by the writer on July 26 and August 9, 1935, as they were running over the trunk of a newly-felled Douglas fir, *Pseudotsuga taxifolia* (Lamb) Brit.

Most other specimens so far recorded were obtained on the flowers of the ocean spray, *Spiraea discolor* Pursh., during the month of June. It would appear that this beetle has a longer period of emergence than hitherto suspected.

(2) *Pidonia quadrata* Hopping. First described and recorded for Vancouver Island from Clayoquot by R. Hopping (1931). The Clayoquot specimen is designated as a paratype and was collected by G. J. Spencer. Two additional specimens were obtained by M. L. Prebble from the Great Central Lakes area on June 27 and 29, 1941.

This very distinctive little species closely resembles *P. scripta* LeC. one of our most abundant members of the genus, but of all the hundreds collected from the eastern and southern portion of the Island, none has so far been noted to include this species. It would seem therefore to favour the more humid regions of Vancouver Island.

(3) *Pachyta armata* LeC. New locality

record: Forbidden Plateau, on the flowers of *Heracleum lanatum*, August 1943, G. C. Carl. This constitutes a northern extension of its known Vancouver Island range, previous records being from Mount Arrowsmith (Hardy 1936).

(4) *Evodinus vancouveri* Csy. New locality records: Forbidden Plateau, July 11, 1930, J. D. Gregson. Great Central Lakes, May 17, 20, 22, 1941, M. L. Prebble and K. Graham. These constitute a northern extension of the known range on Vancouver Island. Contrary to expectations none of the specimens examined from the Island include the black form, which from specimens available appears to be of more frequent occurrence on the adjacent mainland of British Columbia.

(5) *Leptura propinqua* Bland. New locality record: Beaver Creek, Alberni, July 27, 1934, W. H. A. Preece. This extends its known ranger farther to the north, Duncan being the only other Vancouver Island locality record to my knowledge. In general it is a mountain species; I have records of its occurrence on Mount Cheam, Mount McLean, Garabaldi Park and the Olympics, on the mainland.

(6) *Anoplodera nigrella* (Say). First record known to the writer for Vancouver Island: Forbidden Plateau, July 11, 1930, J. D. Gregson. This is one of those captures that give a zest to the examination of hundreds of the common *A. dolorosa* with which it might be confused in the field. The species occurs throughout western Canada and the United States from British Columbia to Nova Scotia.

Craighead (1923) records that adults were taken in pupal cells on August 20, in Oregon. It is not clear whether this indicates a very late metamorphosis or nearly a year in this condition. It breeds in *Pinus*, *Picea*, and *Pseudotsuga*.

(7) *Anoplodera tibialis* (LeC.). New locality record: Forbidden Plateau, August 28, 1943, G. C. Carl. The only other known Vancouver Island locality record is Duncan, based on one specimen in the Hanham collection. It is a mountain species having a wide distribution from British Columbia to Newfoundland. Fall (1926) records it from Skagway, Alaska. Specimens from the mainland of British Columbia are represented in the Provincial Museum from Mount McLean, Mount Cheam, Vernon and Garibaldi.

(8) *Anoplodera canadensis* (Oliv.) New locality records: Beaver Creek, Alberni, July 27, 1934, W. H. A. Preece; two males on flowers of carrot, *Daucus carota* L. Cowichan Lake, August 17, 1938, W. G. Mathers, one male. Mr. A. W. Hanham has taken it on the flowers of tansy, *Tanacetum vulgare* L.

All these examples are of the black, red-shouldered form, which seems to be the prevalent form here. I have records of but two of the black phase and none of the entirely red variety from the Island.

(9) *Anoplodera dehiscens* (LeC.). New locality record: Beaver Creek, Alberni, July 27, 1934, W. H. Preece. Two specimens on flowers of carrot, *Daucus carota* L. This is a northerly extension of the known Vancouver Island range of this decidedly scarce species. It is also very occasionally taken in flight in woodland glades.

(10) *Pyrotrichus vitticollis* LeC. This elusive cerambycid seems worthy of comment whenever it is noted on Vancouver Island, which to date has been on only four occasions, so far as I can ascertain. The first is listed by Harvey (1907) with "Victoria" as the only datum, and is probably the same specimen recorded by Hardy in 1927. The second record is from a specimen labelled "Duncan" in the collection of the late A. W. Hanham. The third, a male, was taken by W. Downes on June 10, 1929, in flight at mid-day about a maple tree. The fourth record consists of a number of specimens reared from larvae and pupae obtained by the writer from a dead maple, *Acer macrophyllum*, in January 1935.

The larvae and pupae were found in some numbers in a spot twelve feet from the ground and in the central decaying heartwood. The larvae were feeding in the adjoining solid wood, the pupal cells being constructed near the inside surface parallel to the grain of the wood. On

emergence the adults would have to travel some distance within the tree until a crack or knothole provided an opportunity for gaining access to the open air.

Pupae were fully developed by January 28; the adults emerged during the following April. It was observed that the adults, all females, evinced a decided aversion to daylight; as soon as exposed to its influence they burrowed into the friable rotten wood. In reconciling the behaviour of the two sexes as just stated, it would appear that the male seeks out the more retiring female. If further acquaintance with *vitticollis* should demonstrate a preponderance of females over males this could at least in part account for the apparent rarity of this species.

(11) *Molorchus longicollis* LeC. New locality record: Goldstream, May 30, 1928, W. Downes. This is the most western extension of its range so far noted. All other records are from the east coast of the Island, from Sidney to Duncan where it was observed from the end of April until early in June. Mr. Preece has taken this species in large numbers on a species of cultivated spirea while the late A. W. Hanham reported it on one occasion as "swarming" on the blossoms of the bay laurel.

(12) *Hybodera tuberculata* LeC. New locality record: Cowichan Lake, October 8-19, 1940, M. L. Prebble. This is a western extension of its reported range on the Island, previously being taken at east coast areas from Tod Inlet to Wellington.

This is one of those elusive species that may never be seen for years and then suddenly turns up in considerable numbers at unexpected places on or about its host tree, *Acer macrophyllum*.

The specimens above referred to comprise a nice series of 20 individuals. They vary in length from 9 to 15 mm. and in colour from unicolourous brown to the marked distinction of the two gray bands across the elytra so characteristic of the species. All were taken from their pupal cells in branches of the maple, *Acer macrophyllum*. They would overwinter in the adult stage, the natural period of emergence being April and May.

Another record, Elk Lake, April 29, 1931, has been reported by Mr. Downes who took a good series in flight about four o'clock in the afternoon around a pile of maple cordwood.

(13) *Callidium hardyi* Van Dyke. Attention is drawn to this species in order to avoid any future uncertainty as to the correct type locality. This is Gordon Head, Vancouver Island, not Garden Head as it is spelled in the original description (Van Dyke 1928).

(14) *Callidium vancouverense* Van Dyke. New locality record: Cowichan Lake, May 19, 1941, M. L. Prebble. This is a westerly extension of its known Vancouver Island range. Previous records are from Duncan, Sidney and Victoria districts.

(15) *Phymatodes obscurus* LeC. New locality record: Lakehill, Saanich, July 16, 1941, W. H. A. Preece, two specimens, taken at "light." This is the second record of its occurrence on Vancouver Island. The first consisted of eleven specimens reared by the writer from *Quercus garryana* Dougl., on Mt. Tolmie, 1926. It is of interest to note that the only members of this species taken at large were night-flying.

(16) *Atimia dorsalis* LeC. New locality record: Colwood, 1932-1936, Hedley Peake. This is quite a rare species in collections. The larval stage is passed in trees belonging to the genera *Cupressus, Juniperus, Libocedrus* and *Thuja*.

(17) *Plectrura spinicauda* Mann. New locality record: Cowichan Lake, August 31, 1941 and August 3-20, 1940, M. L. Prebble.

This is perhaps the most intriguing of the Cerambycidae departing as it does from the general type to a very marked degree, resembling a spider more than anything else. It is wingless and therefore only to be found as it crouches in some crack of a tree. Many specimens in collections appear to have been dug out of their pupal cells during the latter part of July to October. With the one exception, August 3, 1940, all of these groups were taken at large, that is from the end of July to the 25th of August. I have records of others

taken from February to May inclusive. This is a further confirmation of previous observations that many if not all of the adults hibernate during the winter outside their pupal cells. (Hardy and Preece 1926, Leech 1938).

(18) *Monochamus maculosus latus* Csy. This is the British Columbia form hitherto going under the name of *maculosus* Haldeman of which it is the western representative. This matter is thoroughly dealt with in a recent study of the genus (Dillon 1941).

A series of eight specimens from Cowichan Lake constitute the first positive record available to me of its occurrence on Vancouver Island. They were collected by M. L. Prebble on August 3, 1940, ovipositing on the lodgepole pine, *Pinus contorta* Dougl.

Two specimens in the Provincial Museum from the A. W. Hanham collection bearing the date of September 9, 1899, and presumed to have been taken by G. W. Taylor of Nanaimo, might possibly be the first examples of this species from the Island and in part are recorded by Harvey (1907), but lack of more definite data would give precedence to those obtained by Prebble. Of the hundreds of specimens of this genus collected in the vicinity of Victoria not one of this species has so far been detected.

(19) *Monochamus obtusus* Csy. First record for Vancouver Island by the writer in 1935. A specimen in Prebble's collection is from Lake Cowichan, August 3, 1940, which thus constitutes a northern extension of range on the Island.

There are also a couple of specimens in the Hanham collection that may have been taken by G. W. Taylor as they bear a label in his handwriting, September 14, 1899, with no indication of locality, but presumably in the vicinity of Nanaimo.

(20) *Saperda populnea* L. New locality record: Lost Lake, Saanich, May 22, 1944, G. A. Hardy. One specimen on leaf of *Salix sitchensis* Bong. Dull windy day, 4 p.m. This appears to be the second record for the Island; the first specimen was taken at Duncan by the writer on July 4, 1926.

ACKNOWLEDGMENTS.—I have much pleasure in expressing my appreciation to the following gentlemen for their ready co-operation in giving permission to look over their material and to make use of information freely submitted: Mr. W. Downes, Mr. J. D. Gregson, Dr. M. L. Prebble, and Mr. W. H. A. Preece.

I should like to pay tribute to the late A. W. Hanham for the assiduousness and constancy with which he collected the Coleoptera of his district for a period of over 30 years. A study of his specimens, now in the Provincial Museum, gives a very good cross-section of the cerambycid fauna of the Duncan area and was an important factor in the preparation of earlier lists of the Vancouver Island species.

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SOME SUGGESTIONS FOR THOSE INTERESTED IN BREEDING LEPIDOPTERA

J. R. J. LLEWELLYN JONES
Cobble Hill, B. C.

INTRODUCTION.—Why breed Lepidoptera? There are several good reasons.

(1) Anyone desiring a good collection of Lepidoptera will find that breeding gives him an ample supply of specimens for his collection which are in the best possible condition.

(2) In the case of species which are liable to considerable variation, a better opportunity is afforded of obtaining a good series, which will show not only the extremes of variation, but also the intermediate stages, thus making the series of far greater interest.

(3) Breeding affords an opportunity to observe, note carefully and record the various stages in the metamorphosis of a lepidopteron and to stress any peculiarities noticed. Much of interest will be noted in regard to the life histories thus obtained, and this should be entered in the "breeding records." Hitherto unrecorded information may be obtained and the sum total of scientific knowledge enhanced.

(4) Occasionally the breeder will be rewarded for his efforts by one or more unusual forms appearing in his cages as the imagines duly emerge. As an example of this, the author records that in breeding a series of *Cosmotriche potatoria* Linn., the drinker moth, a British species, he obtained a number of females whose colour was brown rather than straw coloured, as is the case in typical females.

The cause of the variation was not ascertained, unless it was due to the fact that the larvae, which had been collected in varying degrees of maturity, were subject to near asphyxiation in tin boxes on the way home and had to be resuscitated by administering fresh air in quantity to restore the larvae to health. Could this have been the reason for the unusual female forms? Experiments of a similar nature on other larvae might furnish the answer.

(5) An opportunity is afforded for experiments in the field of hybridization. With Lepidoptera this is a somewhat difficult task, and has only been successful in some cases where closely allied species were involved.

Hybrids have been recorded as resulting from the mating of *Smerinthus populi* Linn. a British species resembling very much a small specimen of our *Pachysphinx modesta* Harris, and *Smerinthus ocellatus* Linn., also a British species, resembling very closely our *Smerinthus cerisyi opthalmicus* Bdv. The resultant moth is of an attractive appearance and may be seen in a few of the larger collections in Great Britain, chiefly those in museums.

Another example is the crossing of *Malacosoma neustria* Linn. and *Malacosoma castrensis* Linn., both British species. A figure of the resultant larva is given by South in his "Moths of the British Isles, Part I," together with brief remarks on the experiments.

A few years ago the author succeeded in crossing a male *Notolophus antiqua badia* Hy. Edw. with a female *Hemerocampa pseudotsugata* Mc D. (Ent. Soc. Brit. Col., Proc. 36: 14-15. 1940.)

Enough has now been said to indicate that the breeding of Lepidoptera is in no sense a waste of time or energy, but on the contrary possesses a very real scientific and economic value apart from its being the best method of obtaining a plentiful supply of specimens for the collection; and a good collection is in itself of considerable value educationally.

We now turn to the consideration of ways and means to successful breeding. These may best be considered under three heads:

A. Concerning ova.
B. Concerning larvae.
C. Concerning pupae.

A. Concerning Ova

The most valuable results will be obtained by rearing from the egg. It entails the expenditure of more trouble than breeding from the later stages, but the results from information and data of all kinds, also in most cases the large number of insects obtained, will well repay the care needed.

Ova may be obtained in several ways.

(1) They may be searched for in likely places, such as on foliage of trees and shrubs, on twigs and branches, or in the crevices of bark. Also they may be found on the cocoons of apterous females as in the case of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata*. In fact few places should escape a search; the best requisites for success are keen eyesight and patience.

(2) It is sometimes possible to follow a female while she is engaged in laying her eggs, note where she settles and after her departure, collect the eggs. By this method the author has obtained ova of *Papilio eurymedon* Luc., *Polygonia oreas silenus* Edw. and *Vanessa cardui* L.

(3) By means of a virgin female.

A newly emerged female will often attract one or more of the opposite sex. This is a well known feature with certain species, such as the British *Lasiocampa quercus*, the oak eggar, and *Saturnia pavonia*, the emperor moth, females of which will attract males from a considerable distance; males will even enter houses to get to the lady of their choice. The apterous females of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata* also have this power of attraction well developed. Some species of *Notodontidae*, the prominents, may be cited, for example, *Pheosia portlandia* Hy. Edw. A crippled female was placed on the trunk of a poplar; next day a male was found in attendance and in due course fertile ova were obtined and a fine series of imagines reared.

(4) By persuading captured females to oviposit. In some instances this is not at all easy. In others it is comparatively simple. Many moths deposit their eggs freely even when confined in a match box, chip box, or any other receptacle. This is true of many of the Arctiidae, as *Arctia caja* L., some Sphingidae as *Smerinthus cerisyi ophthalmicus* Bdv., many of the Phalaenidae and Geometridae.

Butterflies are more difficult and require a large cage attractively furnished to their liking. The old fashioned meat safe is quite useful for this purpose. Air and sunshine are essential. The former must not be overlooked, as butterflies are very subject to sun stroke, if the ventilation system of the cage is bad. Glass is a dangerous substance in the construction of cages unless good ventilation is assured. Other requirements are, the presence of the food plant, some flowers to supply nourishment to the butterflies, or failing these a wad of cotton wool soaked in sugar and water or a little honey; water too should not be overlooked. This is probably best introduced by placing on the floor of the cage a layer of moss which can be well dampened from time to time. In cases where the female is disinclined to lay, it has been suggested that the introduction of one or more males might induce the recalcitrant female to commence operations.

To sum up. Conditions should be made as natural as possible and anything which suggests itself to the lepidopterist as conducive to oviposition should be included. In the above manner *Papilio zelicaon* Luc., *Polygonia satyrus* Edw. and *Vanessa cardui* to mention only a few, may be induced to lay.

Some of the more difficult hawk moths such as *Celerio gallii intermedia* Kirby, and *Celerio lineata* Fabr. will oviposit if given plenty of room and their food plant.

Telea polyphemus Cram. and *Platysamia euryalus* Bdv. will lay fairly freely in any good sized cage or container. The ova are frequently deposited on the sides of the cage or box.

Having then obtained ova, our labours begin.

Eggs should be kept reasonably cool. A porch or veranda is very suitable or failing that, a room with a northerly aspect. This is especially important in cases

where the winter months are spent in this state, as, if the ova are kept too warm, there is grave danger of the larvae hatching before the food plant is available in the spring.

Inspection should be frequent, and daily if the ova are noticed to change colour, as this often points to early hatching.

Fertile and Infertile Ova.—To determine whether ova are fertile or otherwise is not very difficult. Fertile eggs usually show a change of colour after a few days. Green eggs will turn pinkish and later perhaps become purplish or blackish, or of a leaden colour. White eggs too will frequently change to a darker hue.

Some ova are opaque. However, if there is no sign of shrinkage or distortion, the eggs are generally fertile. This applies to all ova. In some cases, where the shells are more or less transparent, the embryo larva may be seen inside and a short time before hatching the head is noticed as a dark speck.

Warnings.—(1) Do not attempt to hasten the hatching of the larva at this stage by introducing the food plant, but keep the ova subject to the same conditions as previously.

(2) Do not disturb a newly hatched larva until it has left the vicinity of the egg shell, as in many cases the first meal comprises this or a portion of it.

B. Concerning Larvae

Newly hatched larvae are best kept in tin boxes with glass tops such as are supplied by dealers in entomological supplies, or if we have a large number of larvae, in tins of a larger size (a "Crisco" tin is very suitable) with a piece of glass placed over the mouth to conserve moisture and prevent the escape of the inmates. The food keeps well under these conditions and therefore it is not necessary to handle the young larva so frequently. When this has to be done, a camel's hair brush should be used.

The first problem is the provision of suitable pabula. In many cases this will be known, but if it is not, it will be necessary either to obtain the information from books, or from some other lepidopterist, or from any lists of food plants that may be at hand. Failing the above sources try by experiment to ascertain the food required. Take a roomy tin and place in it samples of as many plants, trees, or shrubs as may be deemed likely to be acceptable to the larvae. In many cases they will quickly select one or more of the plants offered and feed satisfactorily upon them. If this does not happen, further efforts must be made and other food tendered in the hope of better success. Do not let failure discourage, but persevere.

Sleeves.—As soon as the larvae are large enough, and this must be left to the discretion of the lepidopterist, they should be placed in "sleeves" made of muslin, cheese-cloth or, if it is expected that the inmates will remain on the food plants during the winter, of some stouter material such as calico. These sleeves must be attached to the food plant in such a way as to prevent the escape of the larvae and yet be easy of access for examination from time to time. This is very necessary in order to see that no intruders such as wasps, ants, or earwigs, have gained access to the interior of the sleeves and harmed their precious contents, also to ascertain whether or not the larvae are approaching maturity, in which case it will be necessary to provide them with suitable conditions for pupation.

Flower Pots.—For mature larvae a 10-inch flower pot makes a very suitable and convenient larvarium. In the author's opinion it is quite as good, if not superior to, many of the more elaborate and more expensive breeding cages on the market. These latter cages however, are very useful for keeping the chrysalids of many of our butterflies. The glass fronts enable the appearance of the imago to be noticed before it has time to damage itself as frequently happens if left too long to its own devices. They are also useful for attracting by means of the virgin female.

The flower pots should be filled just over half full with earth of a suitable texture. In this a bottle should be inserted to contain water for the food plant; "Ketchup" bottles are very convenient both

as to size and shape. The bottle should be wrapped in paper to allow of its withdrawal later lest it break in frosty weather and water therefrom harm the insects at a time when they should be kept relatively dry.

When placing the food plant in the bottle care must be taken to ensure that the stems fill the mouth of the bottle; otherwise some of the larvae may find their way into the water and perish. Larvae are very prone to commit suicide in this manner unless checked. If necessary a wad of cotton wool, or any other suitable substance may be used to block the neck.

Moss should be placed over the earth, and bark should not be overlooked. This latter is essential for certain species of *Acronicta,* for example *A. alni* Linn., a British species, and doubtless for its representative in British Columbia, *A. funeralis* G. & R. which frequently though not always chooses bark in which to make its cocoon. It would also be indicated for certain species of Notodontidae of the genera *Dicentria (Ianassa), Schizura* and *Cerura.* If it is not supplied the larvae will wander and eventually die of exhaustion and fatigue.

A sleeve may be attached to the rim of the flower pot outside and tied with string or secured with a rubber band. It should be supported by a wire cylindrical frame which rests inside the pot. This sleeve forms an airy and spacious compartment and prevents the crushing and bruising of the food plant.

Generally speaking, the larvae which spend the winter months as pupae cause very little trouble. This is true also of those which pass through the stage during the spring and summer.

A plentiful and free supply of food plant is most important in order to obtain fine specimens of the imago. To put larvae on short commons results in poor and small specimens, if not in complete failure.

HIBERNATING LARVAE.— These will require more specialized treatment. They fall into two classes.

(1) Those which hibernate when mature, not feeding again but appearing on sunny days in the spring before finally deciding to seek suitable quarters in which to pupate. To this group belong the larvae of *Isia isabella* A. & S., *Phragmatobia fuliginosa* Linn. and the British species *Macrothylacia rubi.*

These larvae, being hairy, often cause considerable trouble. They are subject to attack by fungus, and the attack is usually fatal. Preventative measures must therefore be taken. It will be noticed that these larvae take every opportunity during the early months of the year to sun themselves and in this manner to dry their long hairy coats. Therefore, sun and air would seem to be the best preventatives. Place the larvae in a large flower pot which has been filled with a generous supply of moss and stand it outdoors in a sunny position, but exposed to rain and snow. It is fatal to take these larvae indoors, for if their surroundings become dry, they will shrivel and perish. Even with the above treatment, results are likely to be disappointing.

Probably the best method for the collector to adopt is to obtain the larvae of this group on sunny days in the early months of the year and proceed as above, when the larvae will usually pupate in due course without a high rate of mortality. If however, a large number have been collected in the fall, it might be worthwhile to attempt to induce them to pupate early. Procedure as follows:

In January, bring the larvae, which have been placed in a standard breeding cage for the purpose, and which contains a copious supply of moss, into the house during a spell of cold weather and place them over a radiator, or over the fireplace in a warm room, or better still if available, over the hot pipes in a greenhouse. After a short time, possibly a few hours, they will become active and start to make their cocoons. The temperature should be between 70° and 80° F. in the cages. The moss must be kept well damped during the whole period of forcing or the larvae will dry up and die. It is of course necessary to keep the pupae in the greenhouse, or at least in a warm room, after the forcing. The rate of mortality is likely to be high, but this may be due to the

fact that many of the larvae collected have previously been parasitized. The author has not yet employed this method in British Columbia but has met with fair success in England with larvae of *Macrothylacia rubi* and *Phragmatobia fuliginosa* obtaining his imagines about February, a few weeks after pupation.

For *Isia isabella* forcing is unnecessary as the larvae will winter well in a flower pot with moss. All that appears necessary is to stand the pot in the open in a sunny position. In the spring, the larvae will reappear and eventually seek quarters in which to spin up.

(2) Those which hibernate before reaching maturity.

(a) For hairy larvae in this category belonging to the Arctiidae similar conditions as those mentioned above would be indicated.

The question of forcing does not arise, as the subject must be kept dormant till sufficient food is available in the spring. Again it must be emphasized that it is a fatal mistake to bring such larvae indoors. Plenty of moss in the containers, and the inclusion of the growing food plant, if possible, is necessary. The containers should be kept in the garden in a sunny position. In the spring they should be examined frequently to ascertain whether the larvae have resumed activity, and whenever this is apparent care must be taken to ensure that a plentiful supply of food is within their reach.

Arctia caja L. has been successfully reared in the above manner. Result of an experiment with this species follows:

Out of 423 larvae obtained from ova, 212 were placed in a large breeding cage with moss and growing plants of stinging nettle. The cage was taken into the basement of a house for the winter. Only 6 larvae survived. The remaining 211 larvae were placed in a similar container and provided with the same conditions except that in this case, the cage was placed outside only slightly protected from excess of rain. In the spring, 186 larvae re-appeared and continued to feed. From these 150 pupae were obtained and a fine series of moths resulted, many of them being of the form which possesses the secondaries yellow with black spots instead of the typical red.

(b) For those which winter in a communal tent, or singly in a small hibernaculum, all that would seem necessary is to sleeve them whenever possible on their food plant. If this is not practicable, the tent or hibernaculum must be carefully removed and kept in a cool place such as a porch or outhouse until the spring, care being taken to place it amongst the food plant as soon as the shoots burst in the spring, and before the larvae return to activity.

Basilarchia lorquini burrisonii Mayn, which constructs a tiny cone-shaped hibernaculum is easily wintered in the above way, as the larva re-appears rather late in the spring, usually well after the new shoots have appeared on its food plant. Larvae of the genera *Argynnis*, *Brenthis*, *Euphydryas*, and *Melitaea* are probably best obtained in the spring, after hibernation, when they can be found either sunning themselves on banks or crawling about in the vicinity of their food plants.

Moss should always be supplied in the cages used for hibernating larvae. In support of this opinion, the author cites that while visiting the island of Capri, in the bay of Naples, during the latter part of January 1929, he observed larvae of a species of butterfly, probably of the genus *Euphydryas* or *Melitaea*, active on sunny days and nibbling freely at moss growing on stones and other places in the habitat.

(c) Geometers. Many species of the Geometridae hibernate when small, and these seem to cause no special difficulty beyond the possible necessity for a sleeve of material stouter than the cheese-cloth usually used. This is to prevent damage to the sleeve by winter conditions. Amongst others, *Campaea perlata* Gn. and *Chlorosea nevadaria* Pack. can be reared in this way. Of the latter species, out of 10 larvae obtained, six imagines resulted.

(d) Phalaenidae. These larvae, many of which hibernate, will probably cause

some trouble, and the author reports many failures in this group.

The larvae in most cases burrow into the soil and remain for long periods 'resting', as the term is; during this period they should not be disturbed. Others will creep under stones and roots, or will enter moss where they are sometimes found during gardening operations. If of a species worth keeping, they may be placed in a container with earth and moss, when they will often enter the moss and in due course, pupate. The containers, preferably flower pots, should be kept outside, slightly protected from rain. Do not bring the larvae indoors.

On no account disturb larvae which are about to change their skins or pupate.

DISEASES.—These include injuries, the stings of parasites and diarrhoea. For injuries little can be done. For the stings of ichneumons and the like, it is sometimes possible to remove the eggs, if they have not hatched, and thus save the life of the caterpillar. This may be accomplished by the use of a needle and a pair of tweezers. Great care however, is necessary or the larva may die as the result of the operation.

For diarrhoea: If this condition is caused, as frequently, by eating too succulent or too damp food, it may be relieved by supplying the older and tougher leaves of the plant, at the same time attending to the ventilating of the cages. If on the other hand, it is caused by some virus or epidemic infection, the author knows no satisfactory remedy. This applies too in the case of the fungus previously mentioned. The results in both these cases are usually fatal. Prevention therefore is indicated as the best course to adopt. This would include good ventilation, together with the admission of sunlight to the cages, clean and healthy surroundings and the removal of all substances likely to become mouldy, or centres of infection. Spraying with disinfectant should also help.

C. Concerning Pupae

Most of these present little difficulty. In general they should be kept cool and free from excessive moisture. For those which spend the months of winter in this stage, a north aspect on a porch, or a position at least subject to the outside temperatures and the humidity of the atmosphere, is best. Disturb as little as possible and inspect from time to time. Daily inspection will be necessary as the time for the appearance of the imagines approaches.

Butterfly pupae: Those of the papilios do well if wintered in standard breeding cages. The pupae of *Polygonia*, *Vanessa*, and *Basilarchia* which pupate during the spring and summer months are also conveniently housed in this way. CAUTION. Do not assume that a pupa is dead and throw it away because the normal time for the appearance of the perfect insect has passed. Many species "lie over" one or more winters, especially is this true of certain Sphingidae, Notodontidae and some others.

As an example of this, *Smerinthus cerisyi opthalmicus* Bdv., has been known to spend three winters in the pupal stage. During this year, 11 males and 4 females have emerged after the third winter. *Nadata gibbosa oregonensis* Butl. has also been reared after three winters as a pupa and *Paonias excecata* A. & S., *Pseudohazis eglanterina* Bdv., and *Acronicta hesperida* Sm. after two winters. In the case of the last named species, 5 adults were reared.

The case of *Pheosia portlandia* is interesting. This species would appear to be multibrooded under suitable climatic conditions. On the south part of Vancouver Island at least it appears to be partially double-brooded. From a single batch of ova, 32 imagines were obtained in August and September 1942, 4 in April and May 1943, one in August 1943, and one on May 4, 1944.

Careful examination of pupae seldom does harm. After examination they should be placed on moss and lightly covered with the same.

DAMPING.—This is recommended by some authorities, but it is not, in the opinion of the author, very desirable, especially in cases where the pupae have either been removed from their cocoons or dug up during gardening or by "pupa digging." The natural humidity of the atmosphere

is usually all that is necessary. Mould must never be allowed to appear in any container for pupae.

A FEW DIFFICULT SPECIES.—Some hawk moths as *Celerio lineata* and *C. gallii intermedia* frequently die in the pupal stage. To winter these therefore is difficult and Dr. H. Guard Knaggs in his valuable work "an Entomologist's Guide" recommends forcing.

The pupae are placed in a suitable receptacle on moss and lightly covered with more. This is then well damped and the container placed in a warm room, or better still over the hot pipes in a greenhouse, when the moths should shortly appear. The temperature should be about 70°F.

Some of the prominents too may be found a little difficult. It would appear that the larvae of certain species of *Dicentria (Ianassa)* and *Schizura* though making their cocoons in the fall remain "resting" during the winter months, only pupating a few weeks before the time for the appearance of the imago. Any break in the cocoon, which consists of a more or less transparent substance, seems to be fatal to the larva within. Cocoons of the species of *Cerura* must always be preserved unbroken.

PREPARATION FOR IMAGINES.—It is necessary to make some preparation for the safe arrival of imagines in perfect condition, otherwise disappointment will result through malformations.

(1) The inside of the breeding cages and containers should be somewhat rough to enable the newly emerged insects to crawl to a suitable place and dry their wings. A few twigs are helpful.

(2) When the larva has cocooned in a sleeve, it is often best to open the cocoon a week or two before the insect is expected to appear. The pupa may be left in the cocoon provided that free access to the outside world is assured, or may be removed and placed on a bed of moss. If this is not done, it is likely that the insect will be deformed or even fail to get free from the cocoon. This commonly happens with many species of *Acronicta*. It is sometimes advisable also to open the cocoons of *Platysamia euryalus*.

CONCLUSION.—The requirements for the successful rearing of Lepidoptera may be briefly summed up as follows:

(1) The careful observation of all matters of interest and the due recording of the same.

(2) A plentiful use of a somewhat rare commodity often spoken of as "common sense."

(3) An unlimited supply of patience.

ACKNOWLEDGMENTS AND INDEBTEDNESS.—The author acknowledges his indebtedness to Mr. E. F. Johns, sometime Headmaster of Winton House School, Winchester, England; to Mr. Denis H. Clark an assistant master of the aforementioned School, who gave much valuable advice and help in his early days of collecting.

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NOTE ON DALOPIUS TRISTIS AND D. INSULANUS (Coleoptera, Elateridae). Little is known of the habits of our native **Dalopius**; the following note deals with **tristis** Brown, the commonest species in the southern interior of British Columbia, and **D. insulanus** Brown from the coast.

During the last week of September, 1943, adults of **tristis** (det. W. J. Brown) were found in numbers in the duff under western larch trees two miles south of Needles, B.C. Many of the beetles were still teneral and in their pupal cells; a majority of those fully colored and hardened were males, and some of these had already left their cells. The latter were loosely constructed, unlined, and consisted of dead needles and associated forest litter held together by a few silken threads. They were placed about two inches below the top of the duff. **D. tristis** is one of the first elaterids to appear in the spring, and at Salmon Arm is common on the flowers of Rocky Mountain maple, **Acer glabrum**, in April.

Professor G. J. Spencer found **D. insulanus** (det. H. B. L.) hibernating at Vancouver, B.C., on November 3, 1942. The beetles were between boards in the back yard of his city lot, congregated in numbers up to 30 at a time. None was found on an examination of the same area in late January, 1944.—Hugh B. Leech, Vernon, B.C.

RECORDS OF SOME FLIES AND WASPS COLLECTED AT ROBSON, B. C. (Diptera: Asilidae; Hymenoptera: Ichneumonidae)

HAROLD R. FOXLEE
Robson, B. C.

The species listed were collected by me at Robson, B.C. The asilids were identified by Dr. S. W. Bromley; the ichneumonids, all collected in 1941, were named by Dr. H. K. Townes.

Diptera

ASILIDAE

Laphria vivax Williston.
Asilus placyteras Hine.
Cyrtopogon dassylloides Will.
Dioctria sackeni Will.
Nicocles sp. (Perhaps *N. dives* Loew, at any rate so det. by Prof. Melander).

Hymenoptera

ICHNEUMONIDAE

Coleocentrus occidentalis Cr.—July 13.
Xorides californicus Cr.—June 22.
Xorides cincticornis Cr.—July 13.
Pimpla pedalis Cr.—July 20.
Pimpla sanguinicipes Cr.—Aug. 24.
Lissonota montana Cr.—Sept. 1.
Lissonota frigida Cr.—Sept. 7.
Cryptus altoni D. T.—Sept. 7.
Cryptus luctuosus Cr.—Sept. 14.
Polistiphaga fulva Cr.—Aug. 17 and 31.
Ichneumon variegatus Cr. — Aug. 24, Sept. 7.
Angitia acuta Vier.—Sept. 7.
Exochus flavifrontalis Ds.—Sept. 7.
Ephialtes imperator Krb.—July 13.
Ephialtes manifestator L.—Sept. 7.
(10 additional species, apparently undescribed, were identified to genus only).

THE PARSNIP WEBWORM (DEPRESSARIA HERACLEANA) AND ITS CONTROL IN BRITISH COLUMBIA (Lepidoptera: Oecophoridae)[1]

R. GLENDENNING
Dominion Entomological Laboratory, Agassiz, B. C.

This insect became important as a pest in the lower Fraser valley in 1940, when the growing of parsnips for seed became more frequent.

It is an European insect that has long been known on that continent as a pest. It was known to Linnaeus, but was first properly described by Degeer in 1752. In North America it was first recorded by Bethune, from Ontario, in 1869, when it was described as a new species, *Depressaria ontariella*, but this has since been placed as a synonym of *heracleana*. It was recorded by C. V. Riley (1888) as first found in the United States in 1875.

The moths, which measure one half inch in length and have a wing spread of one inch, are light buff in colour, with lighter underwings margined with a thin dark line. The wings are held longitudinally over the body when at rest. The pupae measure three quarters of an inch in length, are reddish brown in colour, and are smooth and shining. The larvae are yellowish-green, about one half inch long when fully fed, and have a series of black tubercles arising from each segment, which also bear a few black hairs. The eggs are spherical, greenish-yellow in colour, and just visible to the naked eye.

LIFE-HISTORY.—This insect passes the winter in the adult stage, the moths leaving hibernation in May. They then fly to any nearby host-plant coming into flower and deposit their eggs, but they may travel considerable distances in search of host plants, as parsnip stecklings several miles from any previous infestation generally become infested during June.

The moths lay their eggs in the umbels of the small flower heads as these are de-

[1] Contribution No. 2305, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

veloping, but later emerging moths continue to lay after the seeds have begun to form, in late June and early July.

The larvae on commencing to feed, immediately web together the small umbels, and feed on the flowers, bracts and young seed heads. Feeding is completed in about three weeks, when the larvae leave the seed heads and descend to the base of the plant where they bore into the main stem, generally near the axils of the lowest two leaf stalks. Pupation chambers are then hollowed out in the stem by the larvae consuming some of the soft white pith; they pupate there, changing to moths in from ten to fourteen days. Several larvae may enter the stem by the same hole and use the same pupation chamber. The moths emerge from the stem through the holes bored by the larvae on entering. This takes place throughout July and early August, and the moths immediately fly to their hibernation quarters, which are usually the nearest sheds, woodpiles or other situations that offer dry, protected winter quarters.

In one instance, hundreds of moths were found in August sheltering between the folds of empty paper cement bags in an open shed; other favoured locations were piles of closely stacked stakes and fence rails.

The essential feature of the habitat is apparently a dry narrow crevice, one quarter inch or less in depth, which probably protects the moths from mice and other enemies. Although the temperature in the lower Fraser valley may vary from 80 degrees F. or over, to as low as zero, the moths remain quiescent for over nine months without undue mortality, until they leave these winter quarters in May.

Riley mentions that the moths have the habit of creeping into crevices in the soil, but this may have been under cage conditions, as they could hardly survive the winter in such situations.

Host Plants.—In the lower Fraser valley only cultivated parsnip, *Pastinaca sativa* L., and the wild hog-parsnip *Heracleum lanatum* Mich., have been found infested. The wild hog-parsnip is an important host however, and where it occurs in any quantity, has been found to support a large population of this insect. This plant is confined chiefly to acid bogs, and in such locations may be plentiful. It is undoubtedly responsible in large measure for the almost certain infestation of new plantings of cultivated parsnip stecklings, through the free flying habits of the moths.

Close examination of native species of umbellifers, other than *Heracleum* ,viz., *Oenanthe, Angelica, Cicuta* and *Sium*, has failed to show feeding by this insect, and cultivated carrot has been free also. Riley mentions larvae recovered from "the stem of some cruciferous plant" but there is no record of the larvae ever feeding on plants of this family, and if correctly identified, the larvae may have used it owing to the absence of its usual host. Riley also mentions an attempt to rear this insect on wild carrot, but the caged larvae declined to feed on the flower heads, turned to cannabilism or bored into the stem where they pupated.

Natural Control.—In the lower Fraser valley three natural control factors have been noted, but none was sufficiently important to prevent this insect from becoming a pest.

A mortality of 40 per cent took place amongst some moths kept under cage conditions in a natural environment throughout the winter, and undoubtedly many moths die, or are destroyed by predators during this long hibernation period.

A few parasites, both dipterous and hymenopterous have been noted in the field, but none in sufficient numbers to effect appreciable control. Several parasites have been recorded in Europe, and it may be possible for them to be introduced here with advantage in the future.

In 1941, in one location near Fort Langley, large numbers of bats were noted by an observer to be feeding in the evening on the moths as they took flight from the parsnip stems at the height of their emergence. The destruction of the moths would appear to have been almost complete, as later no hibernating individuals could be located in adjacent sheds, though

at another farm, 4 miles distant, where no bats were seen, the moths were found plentifully in nearby sheds.

The hairy woodpecker, *Dryobates villosus* (L) was recorded by Bethune as feeding on the larvae and pupae in the stems.

ECONOMIC DAMAGE.—Garden parsnips, grown for food are not attacked, the damage by this pest consisting only of the destruction of the flowers and seeds by the feeding larvae.

Infestation has reached as high as 80 per cent of the seed umbels in portions of fields adjacent to good hibernation quarters, and when an umbel is infested, practically all the seed is destroyed. Average infestations were about 30 per cent of the crop, which would represent a loss of $100.00 per acre. In one case a grower burned his entire crop owing to a severe and general infestation.

CONTROL.—No cultural control measures that will entirely prevent serious infestation have been found practical, and the application of chemicals is necessary to protect the crop from severe loss. However, the following measures if carried out intelligently will do much to obviate a severe infestation.

Any wild hog-parsnips growing within a mile or two of the cultivated acreage should be scythed off before flowering each year. If hibernating moths are found in appreciable numbers in sheds or in piles of lumber or logs, the sheds should be cleared out of all rubbish and sprayed with diesel or stove oil, and the piles of rails, stakes or lumber re-stacked in cold, wet weather.

It is not possible to avoid infestation by any seasonal planting of the stecklings, owing to the necessity of timely harvesting.

If parsnip stecklings are raised from seed on the same farm where the seed crop is grown, they should not be nearer the seed crop than 100 yards, as larvae occasionally crawl to seedling parsnips and bore into the crown to pupate, thus injuring next year's stecklings by increasing the prevalence of rots.

In the past, arsenical sprays and dusts have been recommended against this insect, but owing to the webbing habits of the larvae this has not been found satisfactory. Dusts containing derris, pyrethrum extracts, and nicotine were tested in 1941 and 1942, but failed to show effective mortality of the larvae in the webs.

In 1942 however, preliminary tests with a proprietory barium fluosilicate dust gave surprisingly good results, which were elaborated in 1943, when cryolite-talc dusts of varying strengths were also tests.

As a result of these experiments it was found that two applications of cryolite-talc dust, 1 part cryolite to 3 parts talc, ten days apart, gave almost 100 per cent control of the larvae in the webs. The first application was made when about five or six webs were noted per plant, and the larvae were from one quarter to one half grown.

The dust was applied by means of a rotary hand duster, and good coverage was obtained by walking down the rows, moving the spout up and down so as to treat both low and high flower umbels.

From 50 to 100 pounds of dust are needed per application to treat adequately an acre of parsnips, according to the height of the plants. The cost of this is approximately from $2.50 to $5.00 per acre per application, which compared with an acreage value of $300.00 for parsnip seed, is quite practical and economical.

The actual cause of the death of the larvae when dusted with cryolite is not known. It does not seem necessary to hit the larvae in the webs, as frequently this cannot occur when they are hidden amongst the tightly folded bracts. However they appear to come in contact with the dust on, or in their webs, and death may occur within four hours of dusting, though usually from 24 to 48 hours are necessary for a 99 per cent mortality.

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RECENT EXPERIMENTAL WORK ON THE CONTROL OF THE APPLE SAWFLY, HOPLOCAMPA TESTUDINEA (Hymenoptera: Tenthredinidae)[1]

W. Downes
Dominion Entomological Laboratory, Victoria, B. C.

In a previous article on the apple sawfly published in the Proceedings of this society (Downes and Andison 1942) reference was made to a preliminary trial of summer oil combined with nicotine sulphate for control of this insect. The results obtained in 1941 were encouraging and it was decided to give this method as thorough a test the following season as local conditions would permit.

The chief difficulty in carrying out experimental trials was the fact that the area infested by the sawfly was almost entirely composed of city and suburban lots and not commercial orchards. The apple sawfly shows strong preferences for certain varieties, the chief of which, among those which have been observed in our work at Victoria, in order of choice are Hyslop crab, Wealthy, Duchess, Gravenstein and King. In the presence of favoured hosts less attractive varieties may be almost entirely neglected by the sawflies and, as few backyard gardens contain more than one or two apple trees of the same variety, it was difficult to find a series of trees of any preferred variety for a critical test.

In 1942 three small suburban orchards were selected for spray trials. Two of these were adjoining properties and the third was close by, so for practical purposes they could be regarded as one. Spraying was carried out immediately after the bloom had dropped. The following formula was used:

Summer oil emulsion (Union Mineral Seal, Visc. 55, S.S.U. 100° F. U.R. 80%)	2 gallons
Nicotine sulphate	1¼ pint
Water	100 gallons
Lead arsenate (Oil concentration 1.21% actual oil)	4½ pounds
Powdered skim milk as emulsifier.	

Lead arsenate has little effect, if any, on the apple sawfly, but was included in the spray for the purpose of controlling various kinds of caterpillars. Several trees were left unsprayed as checks.

The trees were examined for results about one month after spraying when the apples were about one inch in diameter. At that stage the larvae are beginning to leave the fruit and the exit holes, which are quite large, are readily seen. In its early stages a sawfly larva frequently damages several apples in a cluster before finally entering one in which it completes its growth. Fruit scarred by external feeding is included in the injured fruits. Only susceptible varieties are included in the tabulation.

TABLE I
Results of Spraying Experiment in 1942

Variety	Total Apples	Per Cent Injury
Sprayed Trees		
Gravenstein	2421	3.3
Gravenstein	2106	7.8
Wealthy	1274	1.6
Wealthy	1262	2.6
King	865	6.0
King	400	2.2
Jano	262	11.4
Red Astrakhan	471	1.3
Red Astrakhan	149	9.4
Average Injury		5.06
Check Trees		
Duchess	2172	39.1
Wealthy	3165	58.7
Hyslop crab	5378	70.0
Hyslop crab	2002	22.4
Average Injury		47.5

In 1943 it was decided to increase slightly the concentration of both oil and nicotine sulphate to determine whether a higher and more uniform degree of control could be obtained than in the previous year's test. In addition to Union Mineral Seal Oil two other types of low viscosity oils were used—Imperial "Mentor 29" (Vis. 45 to 55 S.S.U. 100°F., U.R. 90%) and Shell "Helix" (Vis. 62 S.S.U. 100° F., U.R. 77%). For the trial a block of 34 trees was selected situated on adjoining lots which in former days had been part of a commercial orchard. It consisted of 8 King, 6 Duchess, 8 Alexander, 2 Gravenstein, 1 Cox's Orange, 2 Wealthy,

[1] Contribution No. 2316, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

1 Winter Banana and 6 unidentified trees. Alexander and five of the unidentified trees proved to be non-susceptible varieties or only slightly so. Several trees did not bear fruit. Oil emulsion was increased to 2½ gallons (1.50% actual oil) and nicotine sulphate to 1½ pint per 100 gallons. Arsenate of lead 4½ pounds per 100 gallons was added as before. The time of application was immediately after blossom fall. Non-susceptible varieties and trees which produced too small a crop are not included in Table II.

TABLE II
Results of Spraying Experiment in 1943

Variety	Sprayed Trees Total Apples	Per Cent Injury
2 Gravenstein	1269	0.17
4 Duchess	3420	0.43
6 King	1318	0.41
1 Wealthy	524	1.15
2 Unidentified	1112	0.90
Average Injury		0.61
	Check Trees	
1 Duchess	1358	35.03
2 King	1537	41.48
1 Wealthy	704	72.57
Average Injury		49.69

TRIAL OF QUASSIA-SOAP SPRAY.—In Europe the most common method for controlling apple sawfly and plum sawfly is to use a quassia spray with or without soap. An attempt made at Victoria in 1942 failed owing to the solution being made too weak. In 1943 a formula mentioned by Thiem (1937) which was used successfully against the plum sawfly, was tried with good results against the apple sawfly on a few trees in a city garden. The quassia solution is prepared as follows: Soak 3 pound of quassia chips in 3 gallons of water for 24 hours and boil for 1 hour; then add ¼ pound of soap and dilute to 10 gallons. The spray was applied on May 18 to seven trees of different varieties consisting of one each of Yellow Transparent, Gravenstein, King, Greening and three unidentified varieties. Examined one month later, the most susceptible variety, Gravenstein, showed 2.69 per cent sawfly attack; the remainder were not attacked or only slightly.

The degree of control obtained with quassia-soap compares favourably with that obtained with oil-nicotine sulphate and the slightly lower percentage of clean fruit obtained (97 per cent compared with 99 per cent) is probably not significant. One disadvantage of the quassia spray is that it is more troublesome to prepare than an oil-nicotine spray. It is also twice as expensive. The comparative costs of the two sprays per 100 gallons for materials at 1942 prices are: oil-nicotine $2.66, quassia-soap $5.78.

CONCLUSION.—The results of experimental work conducted by the Victoria laboratory have shown that a spray of summer oil emulsion combined with nicotine sulphate gives very satisfactory control of the apple sawfly. The best results were obtained with light petroluem oil 55 to 65 S.S.U. viscosity emulsified with powdered skim milk at the rate of 2½ gallons of emulsion to 100 gallons of water (1.50% actual oil) and 1½ pint nicotine sulphate. No apparent difference in results could be observed among the three different brands of light petroleum oil used. On sprayed trees rather more than 99 per cent of all apples set were free from sawfly attack, whereas unsprayed trees showed more than 49 per cent loss and in one case 72 per cent. Only one spray is necessary; this should be applied within a week after petal fall. High pressure is not required in order to get results with this spray; in our trials a bucket pump was used and good results are being obtained by residents with pint-size hand pumps. The principal requirement is to see that the nozzle is held close to the calyces and that none are missed. The addition of lead arsenate makes an excellent combination spray which will rid the trees of caterpillars and other biting insects.

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DEVICES FOR CHARTING AND OBTAINING NATURALLY EMERGED CATTLE WARBLES (Diptera: Oestridae)[1]

J. D. Gregson and G. P. Holland
Livestock Insect Laboratory, Kamloops, B. C.

With the increased attention now being paid to the problem of cattle warbles, and the need for economy in the use of derris and other rotenone-containing roots, which provide the only known practical means of control, it has been considered necessary to reconsider the life-history and ecology of these insects in order to fill certain gaps in our knowledge.

Numerous questions have been asked: What is the average length of time involved from the first appearance of the grubs in the backs of cattle to their natural emergence? Will grubs that emerge in the very early spring survive frosts? How many degrees of frost will they tolerate? If only one treatment can be given when is the optimum time? What proportion of normally emerging grubs matures to flies under natural conditions? Grubs may emerge while cattle are in the barn, while the animals are in the pasture, in a muddy lane, in sunny or shady spots, on dry hard ground, etc.; what are their chances of survival under these various circumstances? Is the puparium subject to mould and parasites? Are mice or birds factors in control? How long will warble flies live? How far can they fly? How good a cattle-finding sense do they possess? These are only some of the questions that require answers.

In attempting to find the solutions to these problems, certain difficulties have been encountered. To overcome some of these, two simple pieces of apparatus have been devised, and are here described.

(1) A Method of Charting Warbles (Fig. 1).

Most of our studies are conducted on local dairy herds. A row of cows is chosen for warble development studies and at intervals of a week or so, each animal is checked to see how the grubs are progressing, and whether any new ones have appeared. As there may be as many as 70 grubs in the back of a single beast it was found difficult to locate a particular warble on successive visits.

To obviate this, a measuring stick was made. This consists of a piece of thin wood five feet long, with a cross bar two feet long fastened one foot from the end. The long stick is marked at two-

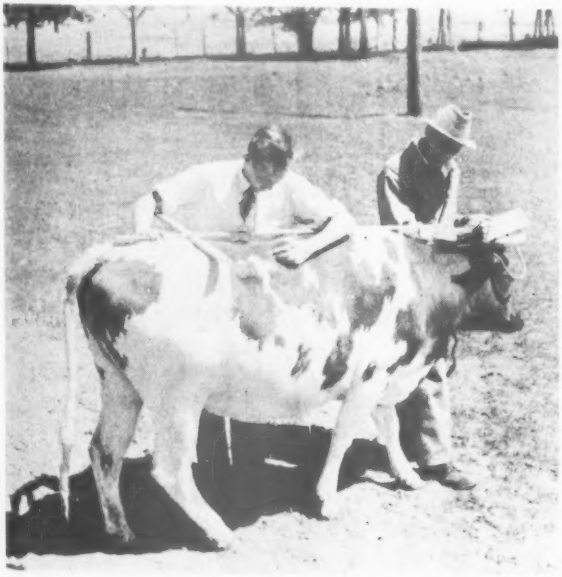

Fig. 1.—Warble Charter in Use.

[1] Contribution No. 2314, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

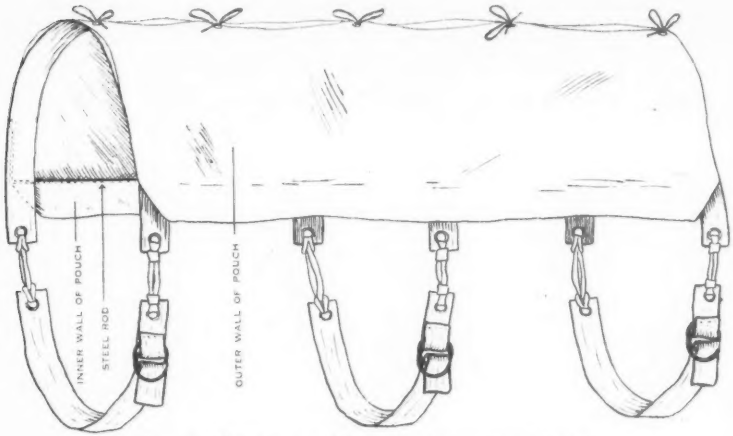

Fig. 2.—Device for Obtaining Emerged Warbles.

inch intervals with numbers from 1 to 30. The cross bar is similarly marked but the divisions are lettered A, B, C, D, etc., on each arm.

The stick is placed with the long member running along the animal's vertebral column, and with the cross piece exactly even with the projecting pelvis (hook) bones. The location of any grub may then be expressed by a number and a letter—on the right side or the left—as 8A, 10C, 17D, and so on. Furthermore, an arbitrary series of numbers from one to five indicates the relative development of the grubs as follows:

Size 1—barely perceptible to small
2—small to medium
3—half to three-quarter grown
4—mature and ready to emerge
5—empty cysts.

Cards have been printed on which to record these data. On one side is a square chart representing the cow's back, lettered and numbered in the same manner as the stick. On the other side there is space for the date, locality, name of herd, row and stall of the particular animal, its breed, colour, age and other pertinent details.

Thus a complete seasonal record may be kept for each animal, and the development of each grub traced from first appearance to maturity.

(2) A DEVICE FOR SECURING NATURALLY EMERGED GRUBS (Fig. 2).

In experiments using adult flies, or in determining the normal pupal period, it is necessary to have numbers of naturally emerged grubs. In 1943 rearing experiments were conducted with mature grubs that had been squeezed out very carefully and gently by hand. Due to the unavoidable mechanical injury these grubs did not survive. As it is impractical to follow a cow around, waiting for a grub to fall out of its back, some means of obtaining uninjured grubs in fair numbers had to be invented.

Officers of the United States Department of Agriculture overcame the difficulty by enveloping the body of the animals with bagging; others have applied capsules over individual warble cysts (Bishopp et al., 1926). The first method is awkward, and the capsules are apt to be scratched off.

Our apparatus consists of two canvas pouches, twenty-four inches long and three inches deep, one on each side of the animal. The inner margins of the pouches —those against the sides of the cow—are reinforced by one-eighth inch spring steel rods: the type used by upholsterers for spring work was found to be most satisfactory. At the ends of the pouches these rods are turned up at right angles for about three inches, then terminated in

small loops to prevent them tearing out of the canvas into which they are sewn.

The outer walls of the pouches continue up as flaps, and are tied together over the animal's back. These canvas pockets are kept in place and are tightly compressed against the animal to which they are shaped by three webbing girdles, which are cinched around the belly. Each of these straps has an elastic insert on each side to accommodate the cow's size before and after feeding. The girdles are adjusted by double ring buckles. As the warbles emerge, they roll down from the back and are caught in the pockets, from which they may be removed daily, and set aside for rearing.

Heavily infested, long-haired beef yearlings proved ideal for our use; as many as thirty-five grubs were collected from five animals in one day under these circumstances. Tame animals are a great asset to success, for under the best of conditions the harness receives rough treatment. For this reason it should be constructed strongly, and sewn with linen thread.

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THE EUROPEAN RED MITE IN THE OKANAGAN VALLEY OF BRITISH COLUMBIA (Acarina)[1]

E. P. VENABLES
Dominion Entomological Laboratory, Vernon, B. C.

This paper records certain observations regarding the economic importance of the European red mite *Paratetranychus pilosus* (C. & F.) and the effect that control measures may have upon the development of infestations in the Okanagan Valley of southern central British Columbia.

The potential importance of the European red mite has frequently been stated in terms of devitalization of the foliage resulting in loss of leaves, reduction in size and colour of the fruit, and failure on the part of the tree to produce fruit buds. The extent to which the entomologist is justified in leading the orchardist to expect such cumulative injury, should depend upon observations made in his own particular district over a period of years, rather than upon reports from other parts of the country or from obsolete literature.

In infested irrigated orchards of the Okanagan Valley, it is very doubtful if defoliation ever occurs, although yellowing and bronzing of the leaves is commonly observed where the mites are numerous. Trees in this condition may lose many of their leaves following the application of summer oil. In non-irrigated orchards on the other hand, defoliation may be of common occurrence as noted by Newcomer (1941) in Washington State. Infestations in Eastern Canada and the United States, where irrigation is not usual, are also accompanied by loss of leaves and other resulting symptoms. It is well known that the development of many orchard insects is profoundly influenced by cultural practices and there can be little doubt that irrigation has an important bearing upon injuries resulting from the attack of mites and scale insects.

The effect of foliage injury upon fruit bud formation would depend upon the stage of bud development when the mite population reaches its height. In the Okanagan Valley, the fruit buds are usually well developed by late June or early July. Heavy mite infestations during May and June would therefore be more liable to reduce bud vitality than later infestations

[1] Contribution No. 2326, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

which would rather affect the colour and size of the fruit. Irrigation during these critical periods would of course, do much to reduce such injuries.

The control of the pest has been the subject of many experiments and the literature dealing with the efficiency of various spray materials is extensive. In drawing conclusions form such experiments, consideration should be given to a number of factors the action of which often renders results conflicting and unreliable. Certain spray materials are known to have a repressive effect upon mite predators. Spray residues on the foliage in some cases, are believed to favour mite survival or render predatory forms inactive. In the Okanagan Valley, it has been observed that in certain orchards, where early sprays have been applied each season for mite control, the winter eggs frequently become sufficiently numerous in the fall to call for a repetition of control measures the following season, whereas in adjoining unsprayed orchards of the same variety, the mite population has remained at a uniformly low level from year to year.

Many years' observations in orchards throughout the Okanagan Valley have led to the following suggestions regarding the probable development of red mite infestations under local conditions. Dormant oil sprays may be relied upon to destroy most of the winter eggs, but infestations frequently develop on such trees later in the season and winter eggs may again become numerous. The application of summer sprays early in the season whilst controlling the mites for a comparatively short period are frequently followed by infestations in later summer. On trees where early sprays are used, the foliage remains green and affords an adequate food supply upon which the surviving mites increase and are able to deposit a normal complement of winter eggs. Sprays applied at midsummer, when the mite population is already declining may produce spectacular results but examination of unsprayed trees in such an orchard will often show that the mites have already disappeared. Ross and Robinson (1922) observed that depletion of the leaves may be considered as a most important natural check. It by no means follows that a heavy deposition of winter eggs will result in a mite outbreak and it has been often noticed that infestations may become serious on trees with relatively few winter eggs.

On unsprayed trees, foliage injury begins early and gradually increases in severity. The leaves on such trees become depleted and the food supply reduced, which is no doubt the cause of the progressive reduction of the mite population so commonly seen in such orchards. This condition may also result in the deposition of winter eggs which, as suggested by Cottier (1934) may be laid by a brood suffering from the scarcity of food. Lack of nourishment may also cause such eggs to be infertile and they are also exposed to the attack of predators for a considerably longer period than those on trees protected by early sprays.

Observations in three orchards in which the intensive mite control program, which had been in force for several seasons, was abandoned in 1941, have shown that whilst the population in 1941 and 1942 was negligible, a very heavy infestation of winter eggs developed in the fall of 1943 and dormant oil was resorted to the following year. The season of 1944 was evidently favorable to the mite and several orchards in different parts of the valley were heavily infested, most of these had suffered from mite attack in 1940 and 1941.

A more careful study of mite activity on unsprayed check trees over a period of years may be of more ultimate value than laborious counts to show the comparative killing qualities of various spray materials. Much information could be gained by arranging with growers who apply mite control sprays to leave a few trees unsprayed. Such trees would represent conditions in a variety of localities and should include different varieties of apples. Systematic examinations in a number of such orchards might be of greater value than the present method of confining observations to single experimental blocks in one locality and would also provide the grower with a direct comparison by which to judge the effect of his own control measures.

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In Memoriam

MAX HERMANN RUHMANN, 1880-1943

It is with deep regret that I record the death of Max Hermann Ruhmann, Provincial Entomologist of British Columbia, which occurred on December 4, 1943 at Tranquille, B.C. Having known him from the time of his arrival in the Okanagan until his death, I may claim the privilege of a long and valued friendship with one whose attainments and knowledge in the field of our own particular science was quite unique.

Max Ruhmann was born on September 9, 1880 at Hzehoe, Holstein, Germany. His early years were spent in Holland and in 1886 his family moved to England where he attended Claremont House School, Wateringbury, Kent. Subsequently moving to Ireland, he attended the Harcourt Street High School, and later studied medicine at Trinity College, both in Dublin. On the outbreak of the South African War he enlisted in the British Army and saw active service with a noted cavalary regiment. In 1902 he returned to Ireland but owing to severe attacks of malaria, contracted abroad, decided to abandon medicine and devote himself to horticulture and it was at Glasnevin Botanical Gardens, then under the direction of his friend Dr. W. Moore, that he laid the foundation of the wide knowledge in pathology and entomology which became his life's work. By that time he had made plans to become a fruit grower in British Columbia, and was already seriously interested in economic entomology.

He was married in 1904 and moved to Canada in 1907, residing in the Kootenay district until 1909 when he came to Vernon. For four years he worked on fruit ranches to gain practical experience. Then in August, 1912, he was appointed to the Provincial agricultural staff as Assistant Plant Pathologist and Entomologist, which position he held until the separation of the pathological and entomological work in 1918. He then became Assistant Entomologist. In 1935 he was appointed Provincial Entomologist and held this office until his retirement due to ill health in December, 1942.

It is as an extension entomologist that Mr. Ruhmann will be particularly missed by the farmers and fruit growers in all parts of the Province. The many well arranged exhibits of injurious insects and plant diseases which he prepared for agricultural exhibitions were of great interest and value, and it was this phase of his work which caused him to be so widely known and so constantly referred to on all matters in which the correct identification and control of insect pests was concerned. Max was a skilled photographer; we are still using illustrations and lantern slides prepared by him when the Provincial and Dominion Entomologists shared the same rooms between 1919 and 1930.

The large and well arranged insect collection housed in the Department office at Vernon was almost entirely the result of his efforts, and bears witness to his painstaking skill. Mr. Ruhmann's personal library included a most complete collection of books and pamphlets, dealing with all phases of entomology, the bulk of which he bequeathed to the University of British Columbia at Vancouver. His attainments as a linguist enabled him to keep abreast of entomological research in various countries and here again, his help in translating and abstracting foreign literature was freely given to all. The most generous of men, one who in the goodness of his heart was always ready to give practical help and advice in matters which often covered a range quite outside of the entomological field, and whose personal interest were always held subordinate to those of his friends in all matters, professional or otherwise, he will be sadly missed.

He is survived by his parents, Mr. and Mrs. W. N. Ruhmann of Vernon, B.C., a son William of Portland, Oregon, and a daughter, Mrs. G. E. Clark of Vernon.

E. P. VENABLES

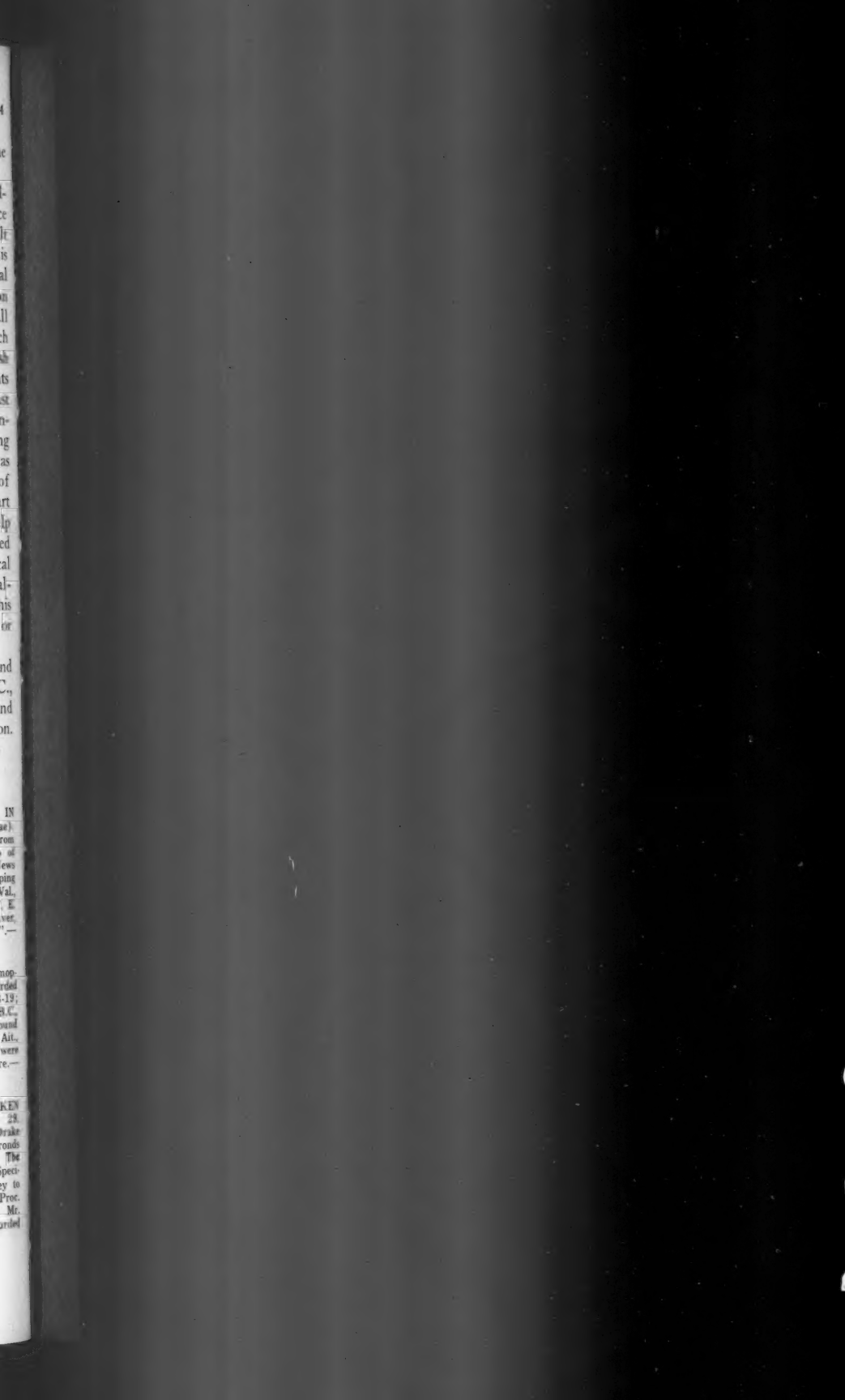
THE BEETLE MELANDRYA STRIATA IN BRITISH COLUMBIA (Coleoptera: Melandryidae). **Melandrya striata** Say, a shiny black beetle with striated elytra, is common in the eastern United States, but Carr's Alberta record (1920. An annotated list of the Coleoptera of northern Alberta; Alta. Nat. Hist. Soc. [Red Deer] 8 p.) seems to be the only one from the north-west. I took a male **striata** at Courtenay, Vancouver Island, B.C., on July 14, 1931; it was identified by Hugh B. Leech, who questioned the locality. However, another male was found at Courtenay on June 30, 1932. Both beetles are now in the collection of the Department of Zoology, University of British Columbia, Vancouver. Unfortunately, I did not keep any record of habitat but according to the literature, the species occurs under bark. There is an illustration of **M. striata** in Blatchley's Coleoptera of Indiana, page 1296, fig. 572.—J. D. Gregson, Kamloops, B.C.

EUCORETHRA UNDERWOODI AT SUMMERLAND, B.C. (Diptera: Culicidae). This chaoborid fly has been recorded from 6 localities in British Columbia by Hearle (1928. Ent. Soc. Brit. Col., Proc. **24**: 17-18), but only one of these, Kaslo, is east of the coast mountains. A female of **underwoodi** (det. A. R. Brooks) was taken on the wing March 31, 1942, beside Trout Creek, about 4 miles west of West Summerland, at an elevation of 2,000 ft. above sea level. Excellent figures of the larva and pupa of this species are given by Johannsen (1934. Cornell Uni. Agric. Exp. Sta., Memoir 164, fig. 158-164).—Hugh B. Leech, Vernon, B.C.

THE FLEA BEETLE ORESTIOIDES ROBUSTA IN BRITISH COLUMBIA (Coleoptera: Chrysomelidae). In 1935 M. H. Hatch recorded **robusta** LeConte from three localities in the State of Washington, two of them at elevations a little above 5,000 feet (Ent. News **46** (10): 276-278). Two specimens in the Hopping collection carry the following labels: "Midday Val., Merritt, B.C., 3. VII. 1924, K. F. Auden" [Det. F. E. Blaisdell, Sr.]; "Grouse Mt., 4,000 ft., Vancouver, B.C., 7. VI. 1931 H. B. Leech" [teste H. C. Fall]".—Hugh B. Leech, Vernon, B.C.

CAMPYLENCHIA LATIPES ON ASTER (Homoptera: Membracidae). W. Downes has thrice recorded **C. latipes** Say in this journal (**12**: 14; **14**: 18-19; **23**: 16), reporting it from Vernon and Penticton, B.C., on willow and goldenrod. On August 4, 1944, I found a colony of adults on wild aster, **Aster multiflorus** Ait., at Vernon. Despite the hot weather the hoppers were inactive and made no attempt to elude capture.—Hugh B. Leech, Vernon, B.C.

THE BUG CORYTHUCHA PADI ON BRACKEN FERN. (Hemiptera: Tingidae). On September 29, 1943, near Needles, B.C., adults of **C. padi** Drake were found in numbers on the underside of the fronds of brake, **Pteris aquilina** var. **lanuginosa** Bong. The bugs were feeding, and not readily dislodged. Specimens were identified with the aid of Downes' key to the British Columbian species (Ent. Soc. B.C., Proc. **22**: 12-19, 9 figs. 1925), and later verified by Mr. Downes, who said that bracken had not been recorded as a host.—Hugh B. Leech, Vernon, B.C.



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NEW MEMBERS

A List of Members, as of May, 1943, was printed on the inside cover of Vol. 40. The following new members were elected at the Annual Meeting of February 26, 1944.

Barss, A. F.—Department of Horticulture, University of British Columbia, Vancouver, B.C.
Braucher, R. S.—316 Orange St., Riverside, Calif.
Francis, Joseph—Pennsylvania Salt. Co., Tacoma, Wash.
Littooey, Edward—2598 Taylor St., San Francisco, Calif.
Mac Bean, Geo.—987 W. 17th Ave., Vancouver, B.C.
Smith, Gordon Stace—Creston, B.C.
Taylor, S. E.—1624 W. 3rd Ave., Vancouver, B.C.
Turnbull, W. H.—Provincial Horticultural Office, Vernon, B.C.

Associate Member

Levey, Archie—Kamloops, B.C.